Dumfries & Galloway Local Biodiversity Action Plan

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Dumfries & Galloway Council




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Photographs

Thank-you to all photographers who allowed free use of several images for this document: Greg Baillie, Gavin Chambers, Gordon McCall, Maggi Kaye, Paul McLaughlin, Richard Mearns and Pete Robinson. Other photographs were provided by the editor and partners. All images are individually credited.

Additional photography: Laurie Campbell www.lauriecampbell.com, Paul Naylor www.marinephoto.org.uk, Steven Round www.stevenround-birdphotography.com, John Bridges www.northeastwildlife.co.uk .

Where possible, the photographs used in this publication have been taken in Dumfries & Galloway. All such photographs are captioned with the place and date that they were taken. Photographs not from Dumfries & Galloway are not captioned with place or date.

Endorsement by the Dumfries & Galloway Biodiversity Partnership

The Dumfries and Galloway Biodiversity Partnership comprises of around 80 local groups, businesses, voluntary organisations and statutory agencies. There is no formal membership or written constitution; any organisation or individual that contributes to achieving the aims and objectives of the Local Biodiversity Action Plan is automatically deemed to be a partner. All partners are committed to understanding, safeguarding, restoring and celebrating biodiversity within the Dumfries and Galloway Council area.

The Partnership is co-ordinated by a Steering Group consisting of around 15 key partners, though membership of the Steering Group is open to all partners. The purpose of the Steering Group is to provide guidance and support to the Biodiversity Partnership in order to make progress on the key strategic biodiversity issues in Dumfries and Galloway. It meets on a quarterly basis, is chaired by an elected chairperson and serviced by the Council's Biodiversity Officer. It has no budget of its own.

The Partnership convenes smaller Working Groups as necessary to address specific issues arising from the Dumfries and Galloway LBAP.

Our Aims

The aims of the Dumfries and Galloway Biodiversity Partnership are:

- To identify and address strategic and/or pan-Dumfries and Galloway biodiversity issues.
- To review and monitor biodiversity actions contained within the LBAP, with reference to the Scottish Biodiversity Strategy Implementation Plans.
- To provide a link between local groups and national biodiversity strategies, action plans and reporting procedures.
- To raise awareness and promote biodiversity by championing individual actions and biodiversity issues generally

Our Commitment

In recognition of the above, we the undersigned pledge our co-operation, commitment and support to the implementation of the Dumfries and Galloway Biodiversity Local Biodiversity Action Plan and undertake to use our best endeavours to:

- Take cognisance of the Dumfries and Galloway LBAP in the day-to-day business of our organisations.
- Identify sources of funding to deliver Dumfries and Galloway LBAP.
- Provide guidance and support to other biodiversity partners.
- Monitor and report on progress with the Dumfries and Galloway LBAP.

Dumfries & Galloway Council

Roger Grant, Chair Planning,
Housing & Environment Committee

Forestry Commission Scotland

John Dougan, Conservator
Rob Soutar, Galloway Forest District Manager
Bill Meadows, Borders Forest District Manager

Galloway Fisheries Trust

Jamie Ribbens, Senior Fisheries Biologist

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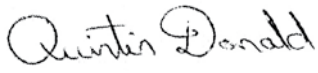
The Scottish Government



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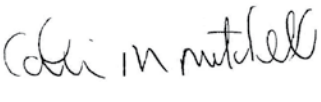

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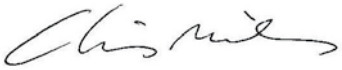

Chris Miles, Area Manager

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Foreword

Dumfries & Galloway has as great a range of biodiversity as you are likely to find anywhere in the UK. With two hundred miles of coastline lapped by the warming influence of the gulf stream, its central position in the British land mass and remarkably varied topography and habitats, the region holds the northernmost of some 'southern' species and the southernmost of some 'northern' species. This 'best of both worlds' bonus applies across a broad spectrum of flora and fauna, including plants, insects and birds. Moreover, this interest encompasses the whole year, with the region being particularly noted for its migrating and wintering waterfowl, including the entire world population of Svalbard barnacle geese, which spend the winter on the Solway - mainly in Dumfries & Galloway.

The term biodiversity was given special significance and prominence at the 1992 Rio `Earth Summit' where the UK and 150 other countries pledged, through the Convention on Biological Diversity, to take local action to look after wildlife and thereby ensure its global sustainability. The resulting publication in 1994 of the UK Biodiversity Action Plan stimulated a plethora of local action plans, including the Dumfries & Galloway Local Biodiversity Action Plan (LBAP). Launched by our partnership in 1999, this was the first comprehensive plan of its kind in Scotland, winning both national and UK awards, and setting a benchmark example for others to follow in the local conservation of biodiversity.

Other sectors and industries had had their plans and strategies for years, but here for the first time was a comprehensive initiative and action plan focusing on maintaining, enhancing and promoting our wonderful wildlife for its own sake, and for the benefit of local people and visitors alike, whilst at the same time contributing to this wider national and international effort as envisaged in Rio.

The achievements of the LBAP are many and varied, but include a superb Environmental Resource Centre, launched by Deputy Minister for Environment and Rural Development Allan Wilson in 2004. This truly first rate community resource receives hundreds of thousands of records and delivers high quality information, training and volunteering opportunities across the region. More than 45 Local Wildlife Sites have been designated and landowners given information and advice to incorporate into their decision making. There has been a significant increase in the restoration of native broadleaves, including riparian planting to benefit salmon. Habitat enhancement has also been undertaken for black grouse and nightjar, whilst there has been significant creation of reedbed and restoration of raised bog. A 'best practice project' has enabled local farmers to establish demonstration sites of good practice in managing for wildlife, whilst biodiversity has been integrated into roadside management by the local authority and the idea picked up nationally, too. Research has been undertaken on merse (saltmarsh) and sparling (a rare fish), whilst vendace, and red kites have been reintroduced into the region.

The LBAP has also benefited wildlife viewing and nature based tourism, with new facilities at Wigtown Bay and the establishment of an annual wildlife festival attracting over 2,000 participants per year. The Galloway Kite Trail was established in 2003 and has made a significant contribution to the local economy as well as encouraging people to enjoy the fantastic spectacle of kites around Loch Ken. These are just some of the achievements of the LBAP; there are many others.

The new LBAP builds on existing achievements and sets out a challenging programme of new actions, reflecting some changes in the national status and priority of species and habitats. For example, the number of priority species found in Dumfries & Galloway is now over 400, and whilst there are existing plans for some of these, naturally they can only be referred to in a document of this size, with more information being available on the web site. Biodiversity remains at considerable threat from land-use and climate changes, and a key challenge for this plan will be to optimise opportunities to maintain and link habitats in ecologically robust networks that can minimise adverse effects on our wildlife in the future.

One of the innovative and exciting aspects of this new plan is recognition that habitats are more than simply collections of species, but also include the physical aspects of the landscape, and what a varied landscape that is! From the grassy heather moors of Langholm and the whaleback hills of Moffatdale, to the shimmering sands of the Solway and increasingly rocky Stewartry coast, back-dropped by the famously rugged grandeur of the Galloway Hills, especially the granite massifs of Criffel, Cairnsmore and the Dungeon Hills. Beyond these to the west lie the magical Machars, Moors and Rhins of Wigtownshire, which have an almost Hebridean quality, bounded as they are by stunning lichened cliffs and shining seascapes. The new LBAP reflects the importance of these physical aspects in a new section on geodiversity, which it is hoped will help to protect and raise awareness of these physical riches upon which our wonderful biodiversity depends.

It is now a statutory duty upon all public bodies to have regard to the protection and enhancement of key biodiversity in the undertaking of their work, and various legislative instruments and processes require rigorous environmental assessment of proposed new developments to ensure this. However, it is local pressure and local action that will deliver the desired halt in biodiversity loss and generate habitat enhancement, and this can only be achieved by continually engaging communities and young people in the wonder and needs of their wildlife. This document plays a key role in this and should therefore be used by everyone, from individuals to large companies and other organisations, as a starting point in learning more about our biodiversity and as a guide in finding out what we can all do to protect and enhance it for future generations to enjoy.

Chris Rollie
RSPB Area Manager

INTRODUCTION

The first edition of the Dumfries & Galloway Local Biodiversity Action Plan (LBAP) was published in June 1999. It was one of the first LBAPs in Scotland and went on to win the Royal Town Planning Institute's Scottish Award for Quality in Planning and the Scottish Silver Green Apple Trophy for Environmental Best Practice.

Since 1999, more than 80 organisations have become part of the Dumfries & Galloway Biodiversity Partnership, and have taken positive action towards LBAP targets. Individuals, land managers, communities, businesses, voluntary environmental groups and statutory agencies have all contributed successful projects, large and small, that have helped protect and enhance the special biodiversity of Dumfries & Galloway.

But much has changed since 1999. This document updates the Dumfries & Galloway LBAP and provides new targets for the years ahead that will enable everyone to further the conservation of biodiversity in the region.

What is Biodiversity?

Biodiversity is short for biological diversity. It simply means the variety of life - the great richness of living things in the natural world, everything from the smallest insect to the largest whale, from tiny toadstools to huge ancient trees. Biodiversity is more than just a few rare animals and plants; it includes the huge array of species and habitats, the genetic variation contained within these, and it includes people.

Making best use of the Dumfries & Galloway Local Biodiversity Action Plan

The Dumfries & Galloway Local Biodiversity Action Plan is intended as a working document to be used by a wide cross section of people to take positive steps to conserve and enhance biodiversity. Different people will use it in different ways, and not all sections will be relevant to everyone. Rather it should be used as a tool to guide conservation action in those areas where the reader can make the greatest difference. For many people this might mean relatively small-scale improvements in the garden; for foresters, farmers, engineers and other land-managers biodiversity improvements will affect greater areas of land; whilst planners and decision-makers will be able to build biodiversity into wider strategic issues. In order to assist with this, the LBAP has been laid out with the following sections:

- **Key Issues** are large-scale issues that will exert a significant influence on biodiversity and its management throughout the lifetime of the plan.
- **Overall Aims** are the key outcomes that the LBAP aims to achieve.
- **Central Objectives** are overarching objectives that will, if implemented, result in significant benefits for all biodiversity across the whole of Dumfries & Galloway. These will be achieved by specific **Central Actions** and/or actions contained in Local Habitat Action Plans.
- **Local Habitat Action Plans** present detailed actions for individual habitats. Semi-natural habitats are classified largely by ecological criteria, whilst highly modified habitats are grouped primarily by different land-uses. However, this is not a scientific classification. Whilst all land in Dumfries & Galloway is covered by at least one action plan, relevant information for some types of habitat may be found in more than one plan. The plans are cross-referenced to facilitate this. Those habitats considered of greatest important for biodiversity are termed Local Priority Habitats.
- **Species Statements** provide an overview of the status, distribution, threats and opportunities for each of the species groups. Unlike the first edition of the LBAP, there are no new detailed Species Action Plans, as the majority of species actions are best achieved through habitat actions. However, the published Species Action Plans from the first edition are still available and will continue to be relevant for much of the lifetime of this second edition. Existing Species Action Plans will be updated and new Species Action Plans published in the future as necessary. Those species considered of greatest importance in the region are termed Local Priority Species.
- **Lead Partners** are identified next to all Central and Habitat Actions. The role of a lead partner is to co-ordinate implementation of an action, but it is expected that other partners will have a role to play in virtually all of the listed actions. As with all local biodiversity action plans, this document is not a statutory requirement and therefore takes a voluntary rather than compulsory approach. Lead partners have committed their support and co-operation to the plan, but uncertainty about future resources and other commitments means that they may not be able to complete all actions.



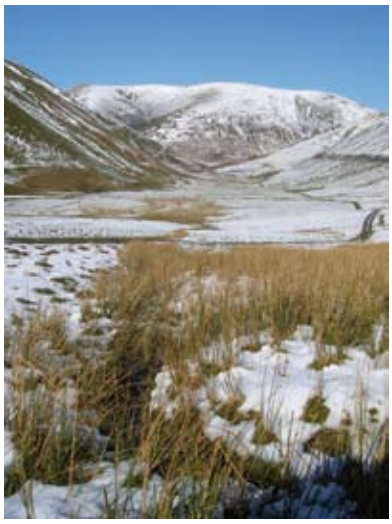

KEY ISSUES

Since the first edition of the Dumfries & Galloway Local Biodiversity Action Plan in 1999, a number of issues have increased in importance. Each will exert a significant influence on management for biodiversity during the lifetime of this LBAP, and probably well into the future.

Climate Change

1. Background

Climate change is undoubtedly a reality. Climate is the 'average weather', including variables such as temperature, rainfall and wind, over a period of time at a particular location. Climate change refers to a significant variation in the average climate, persisting over decades or more. Over the 20th century, global temperatures rose by around 0.7˚C and 1998 was the warmest year since records began in 1861, with 2005 almost as warm.



Snow may become a rare occurrence in future winters. Dalveen Pass March 2008 (Peter Norman)

Some climate change is the result of natural processes, but changes in global climate have also arisen due to human activities that have altered the gaseous composition of the earth's atmosphere. Gases such as water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) naturally trap the sun's heat in the earth's atmosphere. In doing so they warm the earth's surface by over 30˚C to a level at which humans and other living things can survive. This is known as the '**greenhouse effect'**. Evidence now points to climate change well in excess of natural trends resulting from increased concentrations of greenhouse gases in the atmosphere since the industrial revolution, primarily from the burning of coal, oil and gas.

The extent to which human and natural systems across the world will be affected will vary greatly from place to place. The government funded Climate Change Scenarios for the United Kingdom was published in 2002. In Scotland it is predicted that:

- Annual temperatures averaged across Scotland will rise. In the worst case scenarios this could be by as much as 3.5˚C in the summer and 2.5˚C in the winter.
- Summers will become generally drier. There may only be a slight reduction in rainfall in the northwest but as much as a 40% reduction in the south and east.
- Winter rainfall will increase by 20-35% in the south, east and northeast.
- Average snowfall amounts will decrease, perhaps by up to 90% depending on location, and snowless winters may become normal in some parts.
- Scotland's sea levels will rise, perhaps by up to 600mm.
- Sea-surface temperatures will increase around the entire Scottish coastline.
- Scotland will have more severe extreme rainfall events, with rainfall from storms in 24 hours up by 25%, expected to occur on average every 2 years, especially in the east.

The impacts of climate change are already being observed in a variety of sectors and some biodiversity changes in Dumfries & Galloway can already be tentatively linked to climate change.

2. Implications

Two approaches to climate change are needed – reducing the net emissions of greenhouse gases into the atmosphere, and adapting to the changes that are already inevitable.

Reducing greenhouse gas emissions is essential to prevent massive losses of biodiversity. The Scottish target is to reduce emissions by 2.7MtC (million tonnes of carbon or carbon equivalent) per year by 2010. We all have a part to play. For example, one tonne of carbon is emitted by every household in Scotland leaving a 40W light bulb on for 6 minutes, or emitted by around 20 return journeys by plane from Edinburgh to London.

The management of land can act as a source of greenhouse gas emissions, but also a carbon sink or store. **Carbon sequestration** is a process or activity that removes carbon from the atmosphere through the uptake of carbon by growing plants - a **carbon sink**. A **carbon store** locks up this carbon in organic matter.

Keeled Skimmer, one of several new dragonfly species to move into Dumfries & Galloway in recent years, probably as a result of climate change. Knockman Wood, July 2007. (Pete Robinson).

On a global scale, the greatest stocks of carbon are stored in rocks and soil (65,000,000 gigatonnes of carbon) and the oceans (39,000 GtC). That stored in forests (550GtC) and other vegetation (1400GtC) is small in comparison. However, some 4000GtC are stored in fossil fuels and are being released (at the rate of 6.3GtC per year in 2003). In the short-term, land-use activities have the greatest capacity to remove some of this additional carbon from the atmosphere.

In Scotland, forestry and other land-uses (excluding agriculture) are currently net carbon sinks. Although they emit greenhouse gases (some 8% of total Scottish emissions in 2003), they absorb much more. Furthermore, the size of this carbon sink has increased from 0.8MtC in 1990 to 1.3MtC in 2003, primarily through forest growth. However, the carbon sink function from forestry can be temporary and dependent on the subsequent use of forest products. Absorbed carbon can be released again through forest fires, diseases, and soil disturbance by forestry operations, including planting. Burning wood fuel results in carbon emissions but the net result can be neutral or positive if the carbon absorbed during its growth is taken into consideration, and the wood fuel substitutes for fossil fuels. Substituting timber and wood products for energy-intensive building materials such as concrete and steel can also result in a neutral or positive net balance of greenhouse gases.

Agriculture is less effective in reducing greenhouse gases than other land-uses (12% of total emissions in Scotland in 2003). The main emissions are nitrous oxide from organic and inorganic fertilisers and methane from livestock, with only a small amount of CO_2 from energy use.

Further contributions to minimising climate change could be achieved by a range of land-use modifications:

- Creating new woodlands on soils of low organic content.
- Establishing woody crops, such as short-rotation coppice, as a renewable energy source.
- Expanding the use of wood as a substitute for energy intensive building materials.
- Reducing timber and food miles.
- Encouraging more permanent ground cover such as species rich grassland, heather moorland, and wood pasture.

- Reducing methane emissions from livestock.
- More efficient use of organic and inorganic fertilisers through better application techniques and nutrient management.
- Providing advice to farmers through the Farm Soils Plan, the TIBRE Handbook (Target Input for a Better Rural Environment), and the PEPFAA Code (Prevention of Environmental Pollution from Agricultural Activity).
- Restoring peat bogs.
- Conserving soil organic matter through erosion control, cover crops, crop rotation, and incorporation of crop residue.
- Installing alternatives to so called 'hard engineering' for flood protection, such as natural flood attenuation, which results in fewer greenhouse gas emissions during construction, and sequestration during operation.

Peatlands lock up more carbon per hectare than any other habitat. Barend Moss, near Laurieston, May 2008. (Peter Norman)

All of the above have the potential to produce significant biodiversity gains, as well as other environmental benefits, if they are correctly located and implemented.

Adapting to the predicted impacts will require many different forms of action, including changes to the planning system, a different response to flood risks, new building design and construction techniques, and the modification of business activities. The net effect of climate change on the biodiversity of Dumfries & Galloway remains uncertain, but the likelihood is that many more species will be lost than gained unless measures can be put in place to allow species to adapt to the anticipated changes.

A few species are capable of rapid movement and adaptation and have become common, but many others occur only in very low numbers over a wide area, even if ideal habitat is available. These species rely on occasional genetic exchange over a large area (the metapopulation concept). Areas of unsuitable habitat act as a barrier to this exchange, resulting in small and isolated colonies that are unsustainable in the long term.

Should climate change produce environmental conditions that are no longer suitable for a particular species, then this scenario will be greatly exacerbated. Many species will be prevented from moving by areas of unsuitable countryside, even if new areas with suitable environmental conditions are created elsewhere. To counteract this, action is needed at two levels. Firstly, the conservation and enhancement of key biodiversity hotspots is essential to strengthen the ability of species and habitats to withstand a changing climate. Secondly, restoration of substantial areas of the countryside between these hotspots will allow species to move from place to place and successfully adapt to climate change.

Continued Biodiversity Loss

1. Background

Pearl-bordered Fritillary butterfly, once widespread in Dumfries & Galloway but now very rare. (Peter Norman)

Biodiversity is naturally dynamic. Natural processes lead to fluctuations in populations, and periodically to extinctions. Since the arrival of Mesolithic man, biodiversity has also been affected, both positively and negatively, by human activities. Our current diversity of species reflects millennia of interactions between people and nature.

In the 18th and 19th centuries, and especially in the 20th century, the rate of change dramatically increased. The net result of intensification of land use and other development pressures in both urban and rural areas was a reduction in semi-natural land, estimated at 17% in the 40 years or so up to 1988. As a consequence of fragmentation or degradation of the remaining semi-natural habitats, populations of many species declined to non-viable levels; others were directly destroyed.

In the last two decades, some declines appear to have been arrested or reversed through habitat restoration or species management. This will not be possible for all habitats and species. Restoration of seabed life for example to some, mostly unknown, pristine condition that pertained prior to exploitation is unachievable. For others, it may take a considerable amount of time to reverse adverse trends, though progress is being made in many cases.

Small White Orchid, nearing extinction in Dumfries & Galloway. (Peter Norman)

Of the 45 priority habitats and 391 priority species covered by the first UK Biodiversity Action Plan, monitoring in 2005 identified the following trends:

- 22% of priority habitats and 11% of priority species were increasing.
- 39% of priority habitats and 27% of priority species were declining, but the decline was slowing for 25% of all habitats and 10% of all species.
- The UK trend was unknown for 24% of priority habitats and 13% of priority species.
- Habitat loss/degradation (particularly due to agriculture and infrastructure development) and global warming were the current or emerging threats of significance to the highest proportion of priority species and habitats.

Whilst at global level, the target is ‘to achieve a significant reduction of the current rate of biodiversity loss’, the one addressed at European Union level, is even more ambitious - to halt the loss of biodiversity by 2010. Overall, whilst some signs are encouraging, there is still more to do to meet the 2010 target.

2. Implications

Many favourable trends in biodiversity have been brought about, or assisted, by political or other strategic level intervention, regulation and the promotion and funding of better land and water management practices. Biodiversity Action Plans have identified vulnerable habitats and species for targeted action, but must continue to tackle the many problems that remain, recognising that new concerns will emerge through time.

Environmental Inequalities

1. Background

Easily accessible greenspace is not evenly distributed. Dock Park, Dumfries, July 2008. (Peter Norman)

Biodiversity offers many opportunities and benefits to people, but there are inequalities in the sharing of these benefits.

Nationally, environmental inequalities are now recognised to affect both urban and rural areas. The most deprived communities are often those most vulnerable to the pressures of poor local environments. They tend to have the poorest access to environmental information and the fewest opportunities for people to participate in decisions affecting their local environments. Much of the research to date has centred on air and water quality as affected by industry, energy and transport, but biodiversity benefits are also unevenly spread throughout society. Environmental inequality studies have also been centred in areas of high population, but inequalities of biodiversity are just as likely to apply in sparsely populated areas such as Dumfries & Galloway.

A study by the Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) in 2005 identified the following issues:

- For industrial pollution, derelict land and river water quality there is a strong relationship with deprivation. People in the most deprived areas are far more likely to be living near to these sources of potential negative environmental impact than people in less deprived areas.
- For landfills and quarries and open cast sites the patterns of relationship between deprivation and population proximity is less distinct, with no evidence at a national scale that deprived populations are more likely to live near to landfill sites, and limited evidence for quarries and open cast sites.
- People living in deprived areas are less likely to live near to areas of woodland. However, areas of new woodland have tended towards deprived populations.
- For greenspace, the analysis showed that both the least and most deprived areas in Scotland have high percentages of people living near to a local designated wildlife site, indicating that there is no simple relationship.
- People living in the most deprived areas are more likely to experience the poorest air quality. Levels of nitrogen dioxide are especially concentrated in the most deprived areas.

2. Implications

Environmental justice aims to secure a fairer future, enabling all individuals and communities to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations. It is concerned both with local-level environmental problems and larger-scale sources of pollution, and with both the built and natural environments.

Environmental justice in the biodiversity sector should be achieved through quality of life improvements:

- Tackling problems on the ground leading to improvements in local biodiversity.
- Building biodiversity objectives into regeneration.
- Improving biodiversity in greenspaces and the places people live and work.
- Providing access to biodiversity information and biodiversity learning opportunities for all.

Addressing issues of biodiversity inequality should assist in reducing the social and health disparities, and the spreading of biodiversity awareness and education throughout society will result in significant biodiversity gains.

Agricultural and Forestry Change

1. Background

Farming and forestry are the dominant land-uses in Dumfries & Galloway. They are key contributors to the environment, biodiversity and sustainable development, as well as to the well being of rural communities and local economies.

Forest operations. Garrogill, near Moffat, March 2007. (Richard Mearns)

Historically, the land has been farmed and wood products harvested from it for more than 5,000 years. Both activities have always been subject to constant change. Initially they were practised on the same land - only since the 18th century has there been a clear distinction between farming and forestry and an obvious demarcation of land for one purpose or the other. However, the mid-20th century saw a rate of change for both land-uses never experienced before, largely driven by a desire to yield more food and timber. This resulted in an intensification of production, often at the expense of natural ecosystems, which was exacerbated by entry to the European Economic Community in 1973 and the adoption of the **Common Agricultural Policy** (CAP), together with tax incentives that encouraged large scale conifer afforestation. One result of this was that Dumfries & Galloway became the most heavily forested region in the UK, whilst the numbers of sheep on the remaining open ground increased by around 50%. The late 20th century heralded a further change in both international policy and trade, and increasing environmental concerns.

Ploughing. Dumfriesshire, April 2008. (Richard Mearns)

Since publication of the first edition of the LBAP in 1999, changes to both industries have continued at a rapid rate. **Reform of CAP** in 2003 resulted in the 'decoupling' of agricultural support subsidies from production subsidies, removing the incentive to maximise production. Farmers receive Single Farm Payments in return for meeting an agreed standard of agricultural and environmental practice, but they may also qualify for payments in recognition of work done to deliver additional public benefits such as environmental enhancement, better recreational access or improved animal health and welfare. These are delivered through a system of **Rural Development Contracts**. Since 2007 subsidies for the forestry industry are also part of Rural Development Contracts system.

A range of additional issues will result in further changes for both agriculture and forestry:

Traditional breeds, such as Longhorn cattle, are particularly suitable for grazing many semi-natural grasslands. Colvend, July 2007. (Richard Mearns)

- A requirement to contribute towards mitigating climate change. This may lead to, for example, the production of energy crops and conversion of by-products into energy; making more effective use of renewable resources; managing land to minimise carbon loss; managing methane emissions; reducing other greenhouse gases from transport and other activities, and becoming more energy efficient.
- Due to climate change and competition with land used for energy production, there may be greater demand for land to produce food. This may impact on semi-natural land of high biodiversity value.
- Changing international trading arrangements arising from World Trade Organisation agreements. This may have a major impact on prices, whilst increased market access to the European Union may have further consequences for some sectors.
- Financial pressures resulting from the enlargement of the European Union. This may lead to reductions in the level of subsidies and consequent changes to land management.
- New animal and plant diseases, perhaps exacerbated by climate change and globalisation of trade, requiring higher levels of biosecurity.

2. Implications

Agricultural and forestry change will continue to provide many challenges, but it will also provide new opportunities to influence farming and forestry practices for the benefit of biodiversity. For the foreseeable future, Rural Development Contacts will provide the single largest financial input into biodiversity conservation, affecting the greatest area of land in Dumfries & Galloway.

Higher Priority for the Marine Environment

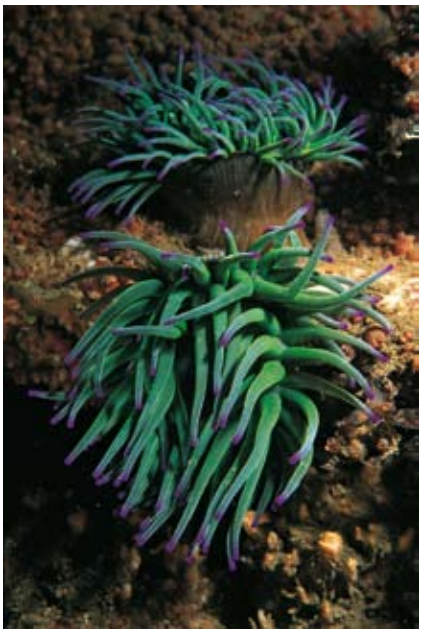
1. Background

Marine and coastal waters are high in biodiversity. They also provide food, recreation and the potential for energy production.

Mauve Stinger Jellyfish. (Paul Naylor)

Nationally, marine policy has a history of haphazard development, presenting a confusing and fragmented management framework to those involved in marine activities. Marine biodiversity and its management have been especially neglected, both in terms of research and public awareness. In Dumfries & Galloway, in comparison to the land, little is known about marine biodiversity and trends. There have been few projects specifically aimed at managing and enhancing marine biodiversity.

Recent initiatives have begun to address these issues, examining how activities interrelate, and aiming to strike the right balance between social, economic and environmental considerations. These initiatives have been driven by the increasing range of potential impacts, including climate change, sea-level rise, renewable energy, commercial fisheries/aquaculture, exploitation of mineral resources, shipping, coastal/marine development, waste disposal and tourism and recreation.



Snakelocks Anemone, mainly restricted to the west coast of Britain including The Rhins. (Paul Naylor)

2. Implications

At a UK and Scottish level new management framework options for the sustainable development of marine resources have been discussed, including a draft Scottish Marine Bill, published in 2008. This is likely to result in policy and legislation changes within the lifetime of this LBAP.

Future changes to marine policy and legislation may result in:

- The establishment of a larger network of nationally important marine protected areas. Locally, Dumfries & Galloway has two marine areas protected under European legislation, at Luce Bay and in the inner Solway. Options for establishing a coastal and marine national park have also been explored.
- The introduction of a marine spatial planning system that guides how and where we use and exploit the sea including fishing, oil and gas exploration, offshore wind development, shipping and coastal development, to avoid conflicts between different users and prevent damage to marine biodiversity.
- Reforms in the laws governing inshore fisheries to provide a viable and sustainable future for fish stocks and fishermen.
- Strengthened laws to protect vulnerable marine species and habitats. For example, a marine wildlife watching Code of Practice has recently been introduced under the Nature Conservation (Scotland) Act 2004.

Flabellina pedata, one of several colourful sea slugs found in coastal waters. (Paul Naylor)

Higher Standards of Water Quality

1. Background

Good quality water is of fundamental importance to biodiversity.

Prior to the rapid agricultural and industrial changes of the 1800s, Scotland's rivers were generally of very good quality. The deterioration of river water quality throughout the 19th and 20th centuries was mainly caused by the discharge of sewage and changes in agricultural and industrial practices that accompanied the economic lifestyle of the time. Significant efforts to restore Scotland's rivers did not occur until the 1960s. Reductions in heavy industry, the enforcement of new legislation and heightened environmental awareness all contributed to improvements in water quality.

The aquatic larvae of stoneflies are good indicators of clean water. (Peter Norman)

In Galloway, acidification of freshwaters increased during the early and mid 20th century. High levels of acidifying pollutants, including oxides of sulphur and nitrogen arising from the burning of fossil fuels and ammonia from intensive livestock rearing, were deposited from the atmosphere. The thin soils overlying hard, slow-weathering rocks had little capacity to neutralise the acidity, and the problems were exacerbated by extensive forestry, as mature coniferous forest filters pollutants from the atmosphere which are then washed into surrounding watercourses. This resulted in acidification of surface waters and significant damage to aquatic ecology. From the end of the 1970s reduced levels of pollutants resulted in a substantial decrease in acidic deposition, followed by more stable concentrations from the 1990s. Attempts have been made to mitigate the effects of acidification, for example by liming of Loch Dee, though such measures cannot provide long-term solutions to the problem. Modifications to forest practice have also reduced the impact, but parts of Galloway remain affected by acidification.

Eutrophication, or nutrient over-enrichment, affected soils and watercourses in Dumfries & Galloway during the 20th century and remains a problem in many freshwaters. Soils have become overloaded with phosphates as a result of nutrient inputs from slurry and fertiliser, together with nutrient-loading from other sources such as sewage treatment works and rural dwellings. These nutrients reach waterbodies through point discharges, such sewage outfalls or farm waste pollution incidents, or more insidiously by percolation through soils, often referred to as diffuse pollution. Eutrophication causes loss of critical water quality resulting in reductions in biodiversity. The development of farm nutrient budgeting is beginning to address such issues.

Since publication of the first edition of the Dumfries & Galloway LBAP in 1999, there has been continued pressure for further water quality improvements. This pressure will be maintained throughout the period of this plan, driven by the requirements of the European Water Framework Directive. This seeks to achieve good water quality across the European Union by 2015, and applies to coastal waters, estuarine waters, inland surface waters and groundwater.

2. Implications

The Water Framework Directive requires the preparation of River Basin Management Plans that have a programme of measures designed to:

- Prevent further deterioration, protect and enhance the status of aquatic ecosystems, and have regard to their water needs and terrestrial ecosystems.
- Promote sustainable water use based on long-term protection of available water resources.
- Protect and improve the aquatic environment, in relation to a progressive reduction in priority hazardous substances.
- Ensure the progressive reduction of pollution of groundwater and prevent its further pollution.
- Contribute to the mitigating the effects of floods and droughts.

Common Reed is increasingly being used to clean water. (Northeastwildlife.co.uk)

OVERALL AIMS

AIM 1: Biodiversity conserved, enhanced and re-created at the landscape and seascape scale.

In order to allow biodiversity to adapt to the predicted changes in climate, there is a requirement to increase the scale at which biodiversity management is carried out. This could be achieved by the large scale creation of new habitats, but in most circumstances it is likely to be more feasible to create **ecological networks** that link patches of habitat that are currently fragmented and isolated. A number of approaches should be adopted and have already begun to reverse this fragmentation and isolation.

Upland grass and heathland, loch and wetlands, native woods and conifer plantations. Glentrool, October 2003. (Peter Norman)

A **forest habitat network** is a landscape structure containing core woodland and forest areas connected by wooded corridors. This allows species of low dispersal ability, or requiring woodland habitat for dispersal, to expand into adjacent habitat patches. It will help maintain and enhance genetic contact within the population of the species and in turn will provide greater species resilience in times of external stress, such as climate change.

A forest habitat network should retain ancient woods and improve their condition, create large woods and well wooded districts, locate new woodland next to existing woodland to minimise isolation, and improve non woodland habitats by restoring scrub and other semi-natural habitat. FCS/SNH recommend at least 30% woodland cover, including some large woods of 20ha or more, though it is not necessary for all woods to be dense closed canopy habitats and there are opportunities to include new wood pastures. The best links are likely to be riparian, as the drainage network is the natural choice for the movement of many mobile species at the landscape scale.

Within Dumfries & Galloway, a practical method to identify key areas for the restoration and expansion of native woodland that links core woods (both native and non-native on ancient woodland sites) is already being implemented through projects such as those of the Cree Valley Community Woodlands Trust, but forest habitat networks will not be practical in all areas. For a variety of reasons, such as landscape, historic environment or economic reasons some areas will be unsuitable. It is also important to avoid fragmenting open habits of high ecological value.

Floodplain restoration is another technique that would allow large-scale enhancement, re-creation and linking of habitats, providing gains for biodiversity and a range of other benefits, including flood alleviation, recreation opportunities and improvements in fisheries and water quality. Allowing floodplains to return to a more natural regime could be achieved by creating washlands, areas of land next to rivers or streams into which flows can be diverted in times of flood. The EU Flooding Directive, which will be transposed into Scots law from September 2007 to September 2009, talks about sustainable flooding and giving rivers more space. It asks member states to “consider where possible the maintenance and/or restoration of floodplains, as well as measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity.”

Tree lines and small woods link together to provide a network for woodland species. Dalry, October 2003. (Peter Norman)

Floodplain restoration is more constrained by physical topography than forest habitat networks, but the two are not necessarily incompatible – both could be created in the same area, providing a mosaic of woodland and wetland mixed with other habitats, agricultural land and settlements. The key to ensuring the integration of these land uses in a holistic way is **catchment management**. Catchments have many

natural linkages, but many of these may be weakened or severed by conflicting land-use practices. Management at the catchment scale enables different land-uses to work together for the benefit of the whole system.

Dumfries & Galloway is a predominantly rural region, with only around 1.3% of land classed as urban, but the concept of landscape-scale habitat restoration should also be applied to urban areas. Whilst it is true that many wildlife species avoid close contact with people, it is equally true that a large number of others have successfully adapted to urban conditions. Furthermore, towns and villages are the most important places for bringing people into contact with biodiversity, providing enjoyment and education, and tackling issues of environmental inequality. **Urban greenspace networks** provide the mechanism for creating and linking biodiversity areas in towns.

Co-ordinated action for biodiversity, as well as other activities, in the coastal and marine environment should be achieved through **integrated coastal zone management**. This process seeks to integrate the different policies and management actions that have an effect on the coast, and at the same time bring together the full range of stakeholders to inform, support and implement these policies and actions in a co-ordinated and transparent process. It will also ensure that regional and local initiatives do not conflict with national priorities for conservation and sustainable use.

AIM 2: Genetic diversity conserved.

Biodiversity conservation has traditionally been focussed at the species and habitat level, but the role of genetics in plant and animal conservation has recently increased in prominence. For example, the Atlantic Salmon that travel thousands of miles in northern seas do not return to just any river headwater to spawn, but almost every one returns to the river where they themselves originated. This behaviour has resulted in genetically distinct stock between rivers and even within individual rivers, with some evidence of further genetic distinctiveness in the tributaries of large rivers. These fish are genetically adapted to the precise environmental conditions found in their natal rivers. In this example, not only would the translocation of large Salmon from one river to another be unlikely to produce future stocks of large fish in the recipient river, but may actually weaken the genetic stock of Salmon in this river.

Planting of Spanish Bluebells has weakened the genetic stock of native Bluebells. Kirkcudbright, May 2003. (Peter Norman)

Future biodiversity actions need to consider the genetic distinctiveness of different species, sub-species or populations. This information may assist in maintaining existing genetic integrity and local adaptations. However, faced with environmental change, the conservation of species adaptability and the processes sustaining and providing diversity might be of greater general importance than conserving specific local adaptations. This gives rise to many questions relating to the role of genetic data in adaptation, response to climate change and in the significance of genetic variation. It may not always be possible to answer these questions without future research, but it is essential to consider the important role of genetics and the risks to genetic diversity when planning biodiversity projects.

AIM 3: Biodiversity incorporated into all relevant decision-making.

The Nature Conservation (Scotland) Act 2004 included a biodiversity duty for all public bodies. The precise wording contained in the Act is:
"It is the duty of every public body and office-holder, in exercising any functions, to further the conservation of biodiversity so far as is consistent with the proper exercise of those functions."

To date, biodiversity management has been seen as something for specialists, but the 'biodiversity duty' makes it clear that it is now something which everyone involved in providing public services should address as a routine part of their decision making. Particular areas of relevance include development programmes and grant schemes; and in policy,

planning, design and development decisions taken by government and business. Environmental assessment procedures specifically address biodiversity issues for specific projects, including cumulative impact. Biodiversity issues now also need to be considered at the strategic level through Strategic Environmental Assessments.

The LBAP should assist in the successful integration, facilitation, co-ordination and promotion of regional biodiversity action. It provides the focus and priorities to enable relevant decision-makers to integrate improved biodiversity management into all relevant plans and projects and ensure that decisions at all levels take account of biodiversity.

AIM 4: Biodiversity awareness, understanding and engagement improved.

A wide range of techniques has been employed to raise awareness and understanding of biodiversity in the UK. The traditional tools have been leaflets, interpretation boards, guided walks & talks, and the media. Ranger Services and voluntary groups have played a vital role. These tools will continue to be important, but more innovative and imaginative forms of communication are also needed to reach a wider range of people, and specific techniques need to be geared to specific audiences. The biggest challenge for the future is to convert awareness and understanding into engagement – closing the gap between 'saying' and 'doing'.

School group visit to Polbower Burn with Kirkconnel Parish Heritage Society. (Greg Baillie)

A Scottish Biodiversity Communications Strategy Framework was commissioned by the Scottish Executive & Scottish Natural Heritage in 2007. This identifies 3 themes that are particularly important for encouraging people to become more involved in biodiversity initiatives in Scotland:

- Acknowledgement that people have lives to live with many things to think about on a daily basis. Biodiversity is not currently their first priority and the challenge is therefore to capture their imaginations in the places they go to and in the ways they will listen.
- That a segmented approach is required, with the term *'nature and wildlife'* being used in communicating for those who are relatively new to these issues, with the term *'biodiversity'* being used only for those who have already had significant exposure to the term and its concepts.
- In order to put people at the heart of the Scottish Biodiversity Strategy, messages about nature and wildlife need to be fun, participatory and enjoyable. Only then will they resonate with the general public and be in a position to create mass behavioural change.

This requires biodiversity communications based on:

- Enjoying: encouraging people to make the most of nature and the natural world.
- Enhancing: people taking steps to make *their* local environment better.
- Protecting: appealing to people's deeper sense of responsibility and ownership.

AIM 5: Natural processes allowed to operate wherever practicable.

The biodiversity of Dumfries & Galloway has been modified by human activities ever since people first arrived in the area. The scale of early modification was extensive and by the beginning of the first millennium BC almost all British habitats had been transformed from their natural state. Today, no truly natural habitats exist and the overall appearance of the landscape is very much a result of human activities. Despite this, the fundamental processes that keep modified ecosystems functioning are no different to those that operate in entirely natural systems. These include photosynthesis and

As water filters through the roots and decaying plant material in this constructed wetland, toxic metals are removed. Craigenbay 1996. (Forestry Commission Scotland)

respiration; pollination and fertilisation; reproduction and growth; colonisation and succession; nutrient, water and energy cycling; precipitation and evaporation; erosion and deposition.

The geographical scale of the human impact has changed little throughout history, but the type of impact and the pace of change have changed enormously. Up until the 18th century, little thought was given to the human impact on the environment. The overriding belief was that people could control and improve on the order of nature, and such change could bring only benefits. During the 19th century, a number of scientists began to recognise one of the basic laws of ecology: namely that everything is connected to everything else and that one change cannot change just one thing in nature. However, the human impact continued to be seen as insignificant until the early 20th century when environmental problems that were once locally confined began to have regional, national and global implications. In very recent times human activities have even begun to fundamentally alter some of the natural processes themselves.

Further change is inevitable, but an approach based on the functioning of ecosystems is now becoming recognised across marine, freshwater, landuse and soil policy, signalling a much more integrated approach to policy development. For example, the presence of predator populations in naturally functioning food chains is a sign of a healthy situation rather than a problem. There is a good deal of work to be done to understand how ecosystems work and to assess their resilience and vulnerability. This includes developing a better understanding of environmental limits, such as robust methods for determining where critical thresholds lie and where cumulative impacts can cause irreversible change. This approach, which was agreed in 2004 by parties to the Convention on Biological Diversity, includes processes, functions and interactions among organisms and their environment, and recognises humans and cultural diversity are an integral part of ecosystems. Some natural processes will therefore not be appropriate in important cultural landscapes, but in many other areas a more natural approach could be applied. This might be restricted to a pond, an entire forest, an intercontinental flyway or even the whole globe, but at all these scales it is fundamental to sustainable development.

AIM 6: Local distinctiveness enhanced.

The biodiversity of every part of Dumfries & Galloway is distinctive and different from every other part. This has resulted from local environmental conditions, a complex history and the current interaction between people and wildlife. For example, low-lying saltmarshes are characteristic of the Dumfriesshire coast, but where they occur inbetween the cliffs and steep slopes of Galloway they not only look different but have a different history of management and even a different local name – the 'Inks' of Wigtown Bay.

Crab Apples are a common component of scrub in Galloway, but scarce in much of the rest of Scotland. Rockcliffe, July 2006. (Peter Norman).

Local distinctiveness is as much about local trees, ponds and their associations with people as it is about local building stone, architecture and pieces of literature. The ephemeral and invisible are important too - customs, celebrations, names, spoken history, myths, legends and symbols. Often it is the commonplace things, the locally abundant, that contribute to local distinctiveness and require attention just as much as the rare and threatened.

The local environmental character of a place does not remain static. Local features are influenced by new people, ideas, activities, and inevitably change. This change may enrich a place or may homogenise and diminish it. There is a danger that blind adherence to published biodiversity guidance and inflexible regulations will result in a loss of local distinctiveness. For example, the woods of Dumfries & Galloway are all different from each other, partly as a result of environmental conditions, but partly as a result of centuries of human interaction and individual management decisions.

In pursuing biodiversity objectives it is worth bearing the following in mind (adapted from Common Ground's Rules for Local Distinctiveness):

- Change things for the better, not for the sake of it.
- Let the character of the people and place express itself.
- Encourage the species that occur naturally in a locality.
- Enhance natural features of local interest.
- Facts and surveys are not the same as knowledge and wisdom of a place. Both ecological expertise and local knowledge need to be used in decision-making.
- Value subjective and emotional arguments. Just because it cannot be counted, does not mean it is not important.
- Make use of the hidden and unseen stories and legends in interpretation.
- Encourage the production of local natural products - such as food and crafts.
- Respect local names and add new ones with care.
- Remember the depth of people's attachment to places. Do not undermine local pride with insensitive change.
- Plan biodiversity projects in proportion and in scale. Every place has its own distinctive dimensions.
- Avoid urbanisation of the countryside.
- Aim for high standards, not standardisation.

LOCAL, NATIONAL & INTERNATIONAL ACTION FOR BIODIVERSITY

Objective 1: Ensure no net loss of priority habitats and species during the lifetime of this plan.

Priority Action (LNIAB1): Ensure that all objectives in the Dumfries & Galloway LBAP are consistent with international and national targets for biodiversity from the following plans and programmes:

- UN Convention on Biological Diversity
- Biodiversity: The UK Action Plan
- Scottish Biodiversity Strategy and Implementation Plans

Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

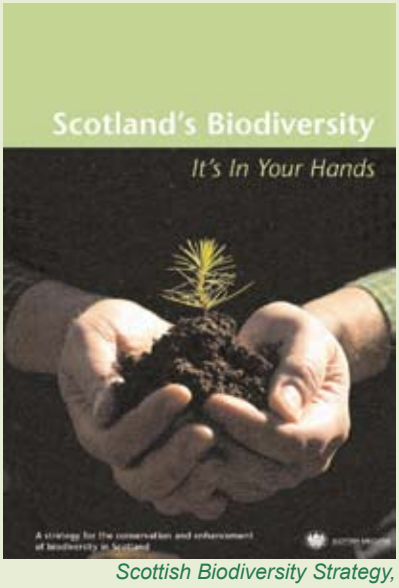
Although locally driven and developed, the Dumfries & Galloway Local Biodiversity Action Plan is part of a national and international programme designed to maintain and enhance biodiversity globally. This LBAP therefore incorporates international and national actions where these are locally applicable.

At the Earth Summit on Sustainable Development in 1992, over 150 countries including the UK Government signed up to the United Nations **Convention on Biological Diversity**. This gave the UK an international obligation to conserve and protect Biodiversity.

In response to the Convention on Biological Diversity, the UK Government produced **Biodiversity: The UK Action Plan** in 1994. A UK Steering Group for biodiversity was established with members from central and local government, statutory conservation agencies, business, farming, universities, non-governmental conservation organisations and others with a stake in land management and use. From 1995, this group produced a framework for action for biodiversity by listing species and habitats which require national action (Biodiversity: the UK Steering Group Report), followed by a series of action plans for individual habitats and species. A review of the entire UK Biodiversity Action Plan was completed in 2007.

The European Union also has a commitment to nature conservation, embodied in the EU Birds Directive (1979), the EU Habitats Directive (1992) and the Natura 2000 network of protected areas under these Directives. The EU developed its own **European Community Biodiversity Strategy** in 1998, which is intended to be complementary to biodiversity strategies developed in individual member states. In 2001 EU Heads of State and Government reaffirmed their commitment at the Gothenburg Summit by pledging themselves to "halt the decline of biodiversity by 2010". This commitment complements the agreement by world leaders in 2002 at the World Summit for Sustainable Development to "the achievement by 2010 of a significant reduction in the current rate of biodiversity loss at the global, regional and national level".

The **Scottish Biodiversity Strategy** entitled Scotland's *Biodiversity: It's in Your Hands*, which aims to conserve biodiversity for the health, enjoyment and wellbeing of the people of Scotland, was published by the Scottish Executive in May 2004. This strategy was developed in close partnership with the Scottish Biodiversity Forum, a broad based working partnership of public, private and voluntary organisations. It represents Scotland's response to its obligations under the Convention on Biological Diversity and to the UK Biodiversity Action Plan, along with the Scottish Ministers' desire to put biodiversity at the heart of our national identity and culture. The strategy covers the period up to 2030. It presents a vision, an aim and five strategic objectives. It also



Scottish Biodiversity Strategy, published in 2004

includes a List of Species and Habitats considered to be of Principal Importance for the purpose of Biodiversity Conservation in Scotland under the Nature Conservation (Scotland) Act 2004 (see below).

To support implementation of the Scottish Biodiversity Strategy, the Scottish Biodiversity Forum produces a set of implementation plans which identify the priority actions to implement the Strategy over a 3 year period. These plans represent the first step towards achieving the Strategy's 25-year vision of Scotland as a world leader in biodiversity conservation.

The **Nature Conservation (Scotland) Act 2004** gives all public bodies a duty to further the conservation of biodiversity, and to have regard to The Scottish Biodiversity Strategy and the Convention on Biological Diversity. The Act came into force on in November 2004 and applies to all public bodies including local authorities, health boards, public utilities, transport agencies, and other public bodies involved in arts, tourism, sport, education or business development.

2. Environmental, Economic and Social Importance of Biodiversity

- National and international strategies and programmes have been developed within the context of sustainable development and are closely linked with social and economic objectives.

3. Factors affecting national and international action

- The complexity of national and international targets for biodiversity, in addition to targets for many other issues, makes implementation at the local level confusing for the non-specialist.

4. Recent and current activity

- The Dumfries & Galloway Biodiversity Steering Group maintains contact and liaison with those working on national and international targets.
- A number of local partners are part of wider national or international organisations.

5. Other recommended actions

- Provide advice to non-biodiversity specialists on the implications of national and international targets at a local level.

6. Further Information

6.1 Publications

- Biodiversity: the UK Action Plan. (1994) Department of the Environment.
- Scotland's Biodiversity: It's In Your Hands. A strategy for the conservation and enhancement of biodiversity in Scotland. (2004) Scottish Executive.
- The Convention on Biological Diversity. (1992) United Nations Environment Programme.

6.2 Websites

- Biodiversity Scotland www.biodiversityscotland.gov.uk
- EU Biodiversity Strategy http://ec.europa.eu/environment/docum/9842sm.htm
- Scottish Executive guidance on the biodiversity duty www.biodiversityscotland.gov.uk
- UNEP Convention on Biological Diversity www.biodiv.org
- UK Biodiversity Action Plan www.ukbap.org.uk

BIODIVERSITY DATA

Objective 2: Ensure that more data relating to Dumfries & Galloway is collected, collated and made available, to assist in the promotion, enjoyment, understanding and enhancement of biodiversity.

Priority Action (BD1): Secure funding to enable the Dumfries and Galloway Environmental Resources Centre to continue to provide a high quality data service to both providers and users of that data.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (BD2): Collect and make available additional biodiversity records.
Target: A total of 250,000 to be available by 2012.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

1. Background

Our understanding of biodiversity remains very limited. For most species and habitats we have insufficient knowledge of what we have and what is happening to it. Although the UK has a longer history of collecting such information and conducting biodiversity research than any other country in the world, much of it has not been made accessible to the public and decision-makers in the right format and at the right time. Furthermore, a substantial quantity of it is likely to have been lost as a result of inadequate and uncoordinated storage techniques.

The position in Dumfries & Galloway is substantially worse than in many other parts of the UK. Not only is the region large and sparsely populated, but until recently it has lacked a university, or major research institute/natural history museum. The Scottish Highlands, which shares many of the same disadvantages, has benefited from a long tradition of visiting naturalists and experts, which has not occurred to the same extent in Dumfries & Galloway.

Moth recording group at work. Raeburn Flow, September 2007. (Richard Mearns)

Even at the basic level of a species inventory, new discoveries are still being made in Dumfries & Galloway at a relatively frequent rate, and not all of these are likely to be species that have recently moved into the area.

Requirements for environmental, including biodiversity, information have continued to rise as the environment has become more integrated into a range of other policy areas. A sound understanding of the region's biodiversity has never been as high a priority.

2. Environmental, Economic and Social Importance of Biodiversity

- Many people participate in wildlife recording primarily as an enjoyable recreation activity, rather than any desire to provide scientific data.
- Collecting and processing biodiversity data can involve people with little previous knowledge or experience of biodiversity, allowing them to learn and develop skills, such as the use of computers, which are directly transferable to other areas of work.

3. Factors affecting biodiversity data

- Although the local demand for biodiversity data amongst the public and decision-makers is high, local **support and funding** for co-ordination of the collection, collation and dissemination of this data remains low.

Training for volunteers in how to find Otter tracks and signs. Langholm, May 2006. (DGERC)

4. Recent and current activity

- The Dumfries & Galloway **Environmental Resources Centre** was established in 2004 as a result of an objective in the first edition of the LBAP. It collects, collates, manages and safeguards relevant data and providing a focal point through which anyone may access the information.
- The **Freedom of Information (Scotland) Act** and **Environmental Information (Scotland) Regulations** control dissemination of biodiversity data.

5. Other recommended actions

- Encourage the collection of new biodiversity data through the co-ordination and training of local volunteers with national recording schemes.

6. Further Information

6.1 Websites

- Biological recording in Scotland www.brisc.org.uk
- Dumfries & Galloway Environmental Resources Centre www.dgerc.org.uk
- National Biodiversity Network www.searchnbn.net

6.2 Advisory Organisations

- Dumfries & Galloway Environmental Resources Centre, Dumfries (01387) 247543

DESIGNATED SITES

Objective 3: Maintain and enhance a network of designated biodiversity sites.

Priority Action (DS1): Survey and assess additional potential Local Wildlife Sites.
Target: 30 additional sites assessed by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Dumfries & Galloway has a high number of statutory sites designated for their biodiversity or geodiversity importance, covering more than 100,000ha of land and water. This includes the following (note that some sites have multiple designations):

- 5 **Ramsar Wetlands of International Importance** covering 33,706ha.
- 17 **Special Areas of Conservation** (SAC) covering 91,963ha.
- 7 **Special Protection Areas** (SPA) covering 48,713ha.
- 97 **Sites of Special Scientific Interest** (SSSI) covering 75,380ha.
- 4 **National Nature Reserves** (NNRs) Cairnsmore of Fleet, Caerlaverock, Silver Flowe and Kirkconnell Flow, covering 9,961ha.
- 2 **Local Nature Reserves** (LNRs) at Castle & Hightae Lochs and Wigtown Bay, covering 2,982ha.

These sites should be viewed as biodiversity hotspots, where there is a concentration of particularly important species or habitats. However, any policy that attempts to conserve or enhance biodiversity solely through designated sites is destined to fail, especially under predicted climate change scenarios. Instead, the biodiversity of designated sites should be maintained, and if possible enhanced, at the same time as improvements in the wider countryside. The species present on designated sites would then have the opportunity to expand their range.

Opening of Mabie Nature Reserve (and Local Wildlife Site) by Butterfly Conservation and Forestry Commission Scotland. July 2007. (Peter Norman)

As a result of the first edition of the LBAP, there are now also 45 non-statutory **Local Wildlife Sites** (LWS) in the region that have been surveyed and agreed with landowners. These sites receive some limited protection through the planning processes, but one of the main benefits they provide is to alert the landowner of the presence of important biodiversity in order that this can be taken into account in management operations.

2. Environmental, Economic and Social Importance of Biodiversity

- Many designated sites provide opportunities for education and enjoyment of the natural heritage. This is particularly the case for National Nature Reserves and Local Nature Reserves.

3. Factors affecting designated sites

- Of the notified features of SSSIs in Dumfries & Galloway surveyed as part of Site Condition Monitoring up to 2006, approximately 31% were considered to be in unfavourable condition, and 69% in favourable condition.

4. Recent and current activity

- **Scottish Natural Heritage** is carrying out Site Condition Monitoring of SPAs, SACs and SSSIs. This identifies sites that are in 'favourable' or 'unfavourable' condition.
- The Natural Care Programme, managed by **Scottish Natural Heritage** has assisted land managers to address management of sensitive habitats in designated sites.
- Funding for the management of designated sites is included in Rural Development Contracts.

5. Other recommended actions

- Continue to identify further sites that are locally important for biodiversity. Work with their owners and managers to secure favourable management.

6. Further Information

6.1 Websites

- SNH Information Service www.snh.org.uk/snhi/

6.2 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

ANCIENT HABITATS

Objective 4: Recognise the value of ancient habitats.

Priority Action (AH1): Develop a set of indicator species that can be used, in conjunction with documentary evidence, to identify local ancient habitats, in order that these habitats should be given special protection and high conservation priority.
Target: Identify local woodland indicators by 2012.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

Ancient woods such as Wood of Cree can never be replaced by new woodland creation. (Richard Mearns)

1. Background

When the ice receded from Britain at the end of the last Ice Age some 10,000 years ago, wildlife began to recolonise. Initially this was assisted by the land bridge that existed with the continent until around 8000 years ago, but even after this was severed the biodiversity of Britain continued to evolve and change according to entirely natural processes. This was not to last. From Mesolithic man onwards, the impact of humans on biodiversity increased. The geographical scale of such changes has always been wide, with perhaps the biggest single change being the clearance of natural woodland across most of Britain by the end of the Neolithic period. However, the intensity and pace of this change has increased exponentially, with the last 100 years seeing some of the biggest transformations. The net result is that none of the natural biodiversity of Britain has been left untouched by man. Those habitats that have been least modified are now termed 'semi-natural'.

As a general rule, semi-natural habitats that have existed for the greatest length of time with the least disturbance generally support the most valuable biodiversity. Most research has been carried out with relevance to woodland, but this rule is equally applicable to the majority of other habitats. In woodland, the term 'ancient' is frequently used and given a precise, if somewhat artificial, definition (see below). For other habitats, what constitutes 'ancient' is less clearly defined. Much depends on the type of habitat; a pond is likely to become 'ancient' at a much younger age than a wood.

Ancient soils are perhaps the key to the biodiversity value of ancient habitats. Soils are much more than a medium into which plants are rooted; they are as much a part of the habitat as the plants and animals and are fundamental to the well-being of that habitat. Those that are disturbed by human activities such as digging, ploughing, and fertiliser application very quickly lose their vital components.

Many woodland plants, fungi and invertebrates spread only slowly within a wood and are unable to cross open country to colonise new woods. They are now confined to **ancient woods**, and if lost from such woods will not recolonise for a very long time, if at all. A number of species are therefore indicative of ancient woods. For example:

- The larvae of *Trachodes hispidus,* a nationally scarce weevil recorded at Carstramon Wood, is usually restricted to rotting small branchwood of oaks and other trees lying on the ground in ancient woods.
- The Point Snail *Acicula fusca* is found mostly in moss and leaf litter in old deciduous woods. It is intolerant of human disturbance and has declined as a result of coniferisation of ancient woods. The Plated Snail *Spermodea lamellata,* the Ash-black Slug *Limax cinereoniger* are also useful ancient woodland indicators.
- Deceptive Featherwort *Adelanthus decipiens* a liverwort indicator of ancient woodland was found in Bargaly Glen in 1975.

Tree Lungwort Lobaria pulmonaria, a lichen indicator of ancient woodlands. (Peter Norman)

An Inventory of Ancient, Long-established and Semi-natural Woodland in Dumfries & Galloway was prepared by the Nature Conservancy Council between 1988 and 1990. It provides information on all sites over 2ha.

Outside of woodland, single trees may be 400 years old or more. Such **ancient trees** are frequently remnants of previous habitats. But even where they have obviously been planted by man the long continuity of micro-habitats that they provide, especially those associated with dead or decaying wood, often support rare lichens and invertebrates that are incapable of spreading more than a few metres to adjacent trees. The greatest concentrations of such trees occur in **ancient wood pastures**, where in exceptional circumstances there may be a combination of ancient grassland and ancient trees together on the same site.

Waxcap fungi *Hygrocybe* are attractive, brightly-coloured toadstools which are readily seen and indicate old, not or very weakly fertilised **ancient grasslands**. They are entirely absent from temporary and recent grasslands. A few species return after 10 or 20 years if no further 'improvement' is carried out, but old unimproved grasslands may contain 20 or more of the 50 species known in Britain. Such waxcap grasslands are of international importance, Britain being their most important European stronghold. Ancient grasslands can also support a wide diversity of flowering plants, though some important waxcap grasslands can be relatively botanically poor.

Peatlands by their very nature are ancient habitats, taking hundreds or thousands of years to form. However, a greater variety of species occur on ancient bogs that are undisturbed, or at least not disturbed or burnt for a considerable period of time. Large hummocks of Austin's bog-moss *Sphagnum austinii* and Rusty Bog-moss *S. fuscum* are largely confined to pristine raised and blanket bogs. Extensive areas of Magellanic Bog-moss *S. magellanicum* and Golden Bog-moss *S. pulchrum* in wet hollows are also typical species of undisturbed peatlands.

It does not necessarily follow that just because ancient habitats are the most valuable for biodiversity, they support the most **species**. There are many examples where recently created or disturbed habitats support a large number of opportunist species that are quick to find and exploit new niches. Spiders are particularly adept at this, and a recent habitat is likely to have many more species than an ancient one. However, the ancient one will support more of the specialist and rarer species. Likewise, raised bogs have rather few flowering plants in comparison to most recent habitats, but many of the species that are found there would be unlikely to survive in other habitats.

2. Environmental, Economic and Social Importance of Biodiversity

- Ancient habitats, by their very nature, have been disturbed much less than other habitats by modern man. They therefore contain some of the most valuable archaeological remains, which often tell us not only about the social lives of previous generations, but about their utilisation and management of these habitats.

3. Factors affecting ancient habitats

- With the exception of ancient woodlands, there is a **lack of knowledge** about the location of ancient habitats.
- A **lack of awareness** of the importance of ancient habitats.

Yellow Meadow Anthills indicate grassland that has not been disturbed for decades. Craig Farm, Balmaclellan, April 2006 (Mary-Ann Smyth)

4. Recent and current activity

- Forestry Commission Scotland has a programme of restoring **plantations on ancient woodland sites** (PAWS) back to native woodland.
- Historic Scotland and the Royal Commission on the Ancient and Historical Monuments of Scotland have completed a **Historic Land-Use Assessment** of the Solway Coast National Scenic Areas. This is a desktop survey using maps, so cannot identify most ancient ecological features, but indicates areas where such features are likely to be found.
- **Restoration of lowland raised bogs** has been carried out at a number of sites.

5. Other recommended actions

- **Identify ancient indicators** for non-woodland habitats.
- **Research the history** of sites and landscapes to identify ancient habitats.
- Ensure that all **ancient habitats are protected** from new development. If in doubt, treat the site as ancient.
- Ensure that **long established management practices** and the timing of them, including grazing, mowing and water level control, are not changed without good reason and clear evidence that new management will be beneficial. However, traditional management practices that have been long-abandoned, such as coppicing or pollarding, should not be reintroduced without a full assessment of the likely results.
- Continue **restoration of known ancient habitats**, such woods and peatlands.

6. Further Information

6.1 Publications

- Thompson, R., Humphrey, J., Harmer, R. & Ferris, R. Restoration of Native Woodland on Ancient Woodland Sites. Forestry Commission Practice Guide. Forestry Commission, Edinburgh.

6.2 Websites

- Ancient Tree Forum
  www.woodland-trust.org.uk/ancient-tree-forum

6.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010
  www.snh.org.uk
- Forestry Commission Scotland (01387) 272440
  www.forestry.gov.uk

NON-NATIVE INVASIVE SPECIES

Objective 5: Minimise the impact of non-native species on biodiversity.

Priority Action (NNIS1): Identify the invasive species in Dumfries & Galloway that pose the greatest threat to biodiversity.
Target: Complete a full risk assessment by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (NNIS2): Raise awareness of the risks posed by non-native invasive species through production of a guide for the public by 2014.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Grey Squirrels are rapidly expanding in Dumfries & Galloway, at the expense of Red Squirrels. (Gordon McCall)

1. Background

The deliberate or accidental introduction of new species to Britain has occurred for thousands of years. These are termed **non-native species,** to distinguish them from native species that arrived as a result of natural processes. An audit conducted by Scottish Natural Heritage identified 988 non-native species present in Scotland; the great majority of them fail to become permanently established. Of those that do, most make a positive contribution to our natural heritage, economy and social well-being, through, for example, agriculture, forestry, horticulture and fisheries.

A few non-native species have taken advantage of suitable conditions and been able to rapidly spread at the expense of native species, dominating habitats and causing environmental damage. These are termed **invasive species**. In some circumstances, such as changes to land management practices, a small number of native species have also spread well beyond their natural ranges and become invasive species, but the majority of invasive species are non-natives.

Invasive species of flora and fauna are rarely as big a threat to biodiversity as habitat degradation and destruction, but they pose a growing problem to certain native species and habitats. Biodiversity on small islands and in freshwaters is particularly at risk. Furthermore, because of the continuing trends in the global movement of people and goods, the potential for these problems to escalate is increasing. Climate change will also have a substantial impact on species assemblages in the coming years – both by affecting the distribution of our native species, and by enabling some non-native species to become more common. Increasingly we could also see more non-native species that are currently benign become invasive as the climate changes.

Co-ordinated effort is required to control the introduction and spread of invasive non-natives. Piecemeal attempts at control ultimately fail due to rapid re-growth or re-colonisation and there is a need for co-ordinated action involving a wide range of agencies and stakeholders. In Britain, a variety of physical, chemical and biological control measures have been employed, but the effectiveness of the methods has varied. Few species have been totally eradicated; none in the marine environment. For some species, control measures and eradication attempts are not viable. Detection, surveillance, and mitigation are equally, if not more, important than eradication or control measures for many species.

2. Environmental, Economic and Social Importance of Biodiversity

- Many invasive species also threaten economic interests such as agriculture, forestry and fisheries. For example, Grey Squirrels cause significant economic losses to commercial forestry.

- The spread of some invasive species, such as Rhododendron, results in wholesale changes to the landscape.

3. Factors affecting invasive species

- A **lack of awareness** of the risks and consequences of the introduction of non-native species and the actions that can lead to their spread, leading to attitudes and behaviour that exacerbates problems.
- **No lead agency** with responsibility to co-ordinate action on invasive species, or any contingency plans to prevent the establishment of new invasive species.

Himalayan Balsam and Japanese Knotweed. Nunholm, Dumfries, August 2007. (Peter Norman)

- **Lack of enforcement** of existing legislation to prevent and control the establishment and spread of invasive species.
- **Limited resources** are available to ensure sustainable action to control established invasive species.
- Limited capacity and resources to improve **detection and monitoring** of invasive species.

4. Recent and current activity

- The Scottish Executive (with the Department for Environment, Food and Rural Affairs and the Welsh Assembly) prepared an Invasive Non-native Species Framework Strategy for Great Britain in 2007. This provides a high-level context for regional or local initiatives.
- Grey Squirrel control is being used as a tool in Red Squirrel conservation. Grey Squirrel Control Officers operating in Annandale & Eskdale are co-ordinating effort to prevent the spread of pox virus by the alien invasive Grey Squirrel.
- Fringed Water Lily has been controlled at Mill Loch SSSI, Lochmaben.

5. Other recommended actions

- **Assess practicality and cost** of controlling/ eradicating invasive species in Dumfries & Galloway.
- **Monitor the spread of priority invasive species** so that appropriate action can be taken to target control.
- **Co-ordinate any control/eradication programmes** with national programmes and those in adjacent areas.
- **Raise awareness** of the activities that may lead to the introduction or spread of invasive species, ways of minimising these risks, and the consequences of not doing so.

Rhododendron ponticum. Tower Wood, Mabie Forest, May2007. (Peter Norman)

6. Further Information

6.1 Publications

- Edwards C. (2006) Managing and controlling invasive rhododendron. Forestry Commission Practice Guide. Forestry Commission, Edinburgh.
- The Welsh Assembly, Scottish Executive & Department for Environment, Food and Rural Affairs (2007) The Invasive Non-native Species Framework Strategy for Great Britain. Protecting our natural heritage from invasive species. Consultation Draft. DEFRA, London.

6.2 Websites

- GB Non-native Species Secretariat www.nonnativespecies.org
- Introduced Species in the British Isles www.introduced-species.co.uk

6.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

Reintroduction and Translocation of Species

Objective 6: Reintroduce or translocate species in Dumfries and Galloway where appropriate.

Priority Action (RTS1): Assess the feasibility and social, economic and environmental benefits of reintroducing key species to Dumfries & Galloway, in line with IUCN guidelines.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

The range of species currently present in Dumfries & Galloway, and indeed the rest of the British Isles, has been greatly modified by human activity over the millennia. Many species have been accidentally or deliberately introduced and a small number of these have become invasive (see above). Others that once naturally occurred in the region have since become extinct. Reasons for their extinction vary, but the most common causes are habitat loss and degradation, or deliberate persecution. The impact of extinctions varies according to species, but the loss of certain key species can affect the natural functioning of ecosystems and result in indirect and often unexpected impacts. For example, the extinction of wolves in Scotland has removed the main predator of deer, meaning that the natural regeneration of native woodlands is rarely possible without human management of deer populations.

A variety of measures should be taken to address these impacts:

Re-introduction is an attempt to establish a species in an area, which was once part of its historical range, but from which it has become extinct. Re-establishment is a synonym, but implies that the re-introduction has been successful. It is also sometimes used in preference to re-introduction, as the latter implies that the species had been previously introduced, rather than was a natural component of the flora/fauna.

Translocation is a deliberate movement of wild individuals to another site, which may or may not have an existing population of the same species. It is usually carried out when populations are threatened by development. It can also include movement of individuals that may cause a potential problem, to suitable habitat where there is less risk of a problem. For example, movement of grazing animals to allow tree regeneration.

Re-enforcement or supplementation is an addition of individuals to an existing population.

Conservation introduction is an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within a suitable habitat and eco-geographical area. This is an appropriate conservation tool only when there is no remaining suitable area left within a species' historic range.

Biological control introduction is an attempt to establish a species from outside its recorded distribution in order to control the population of another species.

2. Environmental, Economic and Social Importance of Biodiversity

- Some reintroduced species are attractive to the public and produce significant economic benefits from tourism. For example, the Galloway Kite Trail was established in 2003 to enable visitors and local people to view reintroduced Red Kites. It links with local tourism businesses and provides a significant boost to the local economy.

3. Factors affecting reintroduction and translocation of species

- Most reintroductions and translocations are illegal without an appropriate licence.
- Reintroductions and translocations carried out with little long-term planning have a high risk of failure, and the possibility of damaging native species. Such reintroductions have been attempted in and around Dumfries & Galloway in

the past, including Ptarmigan in the 1960s/70s. There are however some examples of success, including Mountain Hares and Red Squirrels in the 19th century and Pine Martens in 1981.

- A thorough assessment of attitudes of local people to the proposed project is necessary to ensure long-term protection of the re-introduced population.

Sparling have been the subject of a reintroduction to the River Fleet. (Galloway Fisheries Trust)

- Long-term monitoring is required to assess the success or otherwise of reintroduction or translocation projects. The length of such monitoring will vary according to the species involved, but as a minimum it should include two complete breeding/reproduction cycles, usually longer.

4. Recent and current activity

- Guidelines for re-introductions were published by IUCN - The World Conservation Union in 1995. In summary, these state that introductions should only be considered in the species' former natural habitat and range; in locations where habitat and landscape requirements of the species are satisfied and likely to be sustained for the foreseeable future; where factors that caused the original decline of the species have been identified and reduced to a satisfactory level; that the source population should be closely related genetically to the original native stock; that the source population should not be endangered; that prospective release stock is subject to a veterinary screening process; that adequate funding for all programme phases is secured; and that a pre- and post-release monitoring programme is in place.
- Reintroduction of Red Kites in Dumfries & Galloway by RSPB was carried out between 2001 and 2005.
- Reintroduction of Sparling into the Water of Fleet by Galloway Fisheries Trust and the Fish Conservation Centre was begun in 2007.
- Reinforcement of Sticky Catchfly on the Galloway Coast and Oblong Woodsia fern in the Moffat Hills has been carried out.
- A conservation introduction of Vendace to Dumfries & Galloway was carried out in 1997. The original sites for this species at Lochmaben Lochs were no longer suitable, so Loch Skene, which had no previous history of this species, was chosen instead. It is perhaps now the most important UK site for this species, which is threatened by pollution at its last remaining natural sites at Bassenthwaite and Derwent Water

5. Other recommended actions

- Complete feasibility studies on White-tailed Sea Eagle and Arctic Charr reintroductions.
- Consider reintroducing additional species to Dumfries & Galloway where all IUCN guidelines can be met, there are ecological/environmental benefits, and the long-term economic gains outweigh the initial costs of the reintroduction. Possible species for consideration include Marsh Fritillary and Small Blue butterflies, Freshwater Pearl Mussels and Beavers.
- Restrict translocation to scenarios where it is there is no other viable alternative, and ensure that adequate long-term monitoring is in place.

Red Kite, reintroduced to Dumfries & Galloway in 2001. (Steven Round)

6. Further Information

6.1 Publications

- IUCN - The World Conservation Union (1995) Guidelines for Re-Introductions.
- Joint Nature Conservation Committee (2001) Biological Translocations: A Conservation Policy for Britain. Consultation Draft. JNCC, Peterborough.

6.2 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

WILDLIFE TOURISM

Objective 7: Increase wildlife tourism in Dumfries & Galloway.

Priority Action (WT1): Encourage all interested parties work together to promote wildlife tourism through the establishment of a partnership of local businesses, tourism and biodiversity organisations to assist in the development of wildlife tourism by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.
Priority Action (WT2): Organise and promote an annual Wildlife Festival, in association with partner organisations, VisitScotland and tourism businesses.
Target: Annual festival to attract 5,000 people by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Wildlife tourism is a fast growing sector of the tourism industry in Scotland and identified as one of the 6 key market segments in the development of Scottish tourism in the next decade.

Dumfries & Galloway has many advantages for wildlife tourism:

- A rich wildlife resources capable of attracting a significant proportion of this market throughout the year.
- Some infrastructure for wildlife tourism already in place, including a number of high quality wildlife reserves with good quality visitor facilities.
- Easy accessibility to many other parts of the UK.

Unlike other parts of Britain, Dumfries & Galloway has not yet taken full advantage of its natural advantages for wildlife watching. However, the Area Tourism Partnership Strategy 2007-09 encourages further development, especially Objective 2 'Encourage businesses to take advantage of nature based resources.'

Wild Scotland is the Scottish Wildlife and Nature Tourism Operators Association - a group of wildlife and nature tourism professionals who are all committed to delivering a first class wildlife-watching experience. They aim to encourage the commercial operation, development and promotion of wildlife and nature tourism in Scotland in ways that are sustainable environmentally, economically and socially.

Visitors to the Red Kite Station, Laurieston. (Dean Vaughan)

2. Environmental, Economic and Social Importance of Biodiversity

- Wildlife tourism in Dumfries & Galloway has the opportunity to bring visitors and significant economic benefits to the area at times of the year when other attractions have little to offer.

3. Factors affecting wildlife tourism

- Relatively **little co-ordination of wildlife tourism** activities and marketing, especially between conservation bodies and providers of tourism services.
- A **lack of knowledge and expertise** of wildlife and the facilities available for wildlife watching amongst those in the tourism industry.
- **Poor facilities** for tourists and visitors at some sites.

4. Recent and current activity

- The **Dumfries & Galloway Wildlife Festival** was established by the Dumfries & Galloway Biodiversity partnership in 2004. It takes place during or close to the Easter school holidays and consists of wide range of activities, including guided walks, open days, family activities, art exhibitions and practical conservation work, provided by biodiversity partners across the region. Attendance has risen from around 700 in 2004 to more than 2000 in 2007.
- The **Galloway Kite Trail**, established by RSPB in partnership with local businesses in 2003, is an circular route of some 30 miles around Loch Ken, with an additional 10 miles of forest drive (summer only). The trail includes 6 outdoor viewing points with interpretation, countryside walks, a visitor centre with CCTV (summer only), and a kite feeding station.
- The Farming and Wildlife Advisory Group (FWAG) project, Linking Sustainable Farming, Tourism & Biodiversity, is developing and enhancing opportunities for wildlife and countryside interpretation on **local farms** that have visitor accommodation.
- The free ***Birdwatching in Dumfries & Galloway*** **booklet** was produced in 1997. It is now in its fourth reprint, and more than 100,000 copies have been distributed.

Large flocks of Barnacle Geese are the region's top tourist attraction in winter. Caerlaverock, November 2008. (Northeastwildlife.co.uk)

- There are several accredited businesses in Dumfries & Galloway under the **Green Tourism Business Scheme.** Accreditation is based on a range of environmental criteria, including waste, energy, water, transport and biodiversity.
- A number of partner organisations, for example RSPB and NTS, operate and promote **nature reserves** widely to tourists.

5. Other recommended actions

- Link existing and future wildlife tourism attractions across Dumfries & Galloway in a **co-ordinated marketing** programme.
- **Raise awareness of opportunities** relating to sustainable wildlife watching to the tourism industry and other key stakeholders.
- Ensure a quality and sustainable visitor experience by identifying and **promoting best practice** and adopting appropriate codes of conducts and standards.
- Provide **networking opportunities** for the exchange of ideas on wildlife and tourism-related issues.
- Develop **opportunities on farms** for promoting tourism and recreation rich in wildlife.
- Develop **opportunities on caravan sites and holiday parks** for promoting wildlife tourism.

6. Further Information

6.1 Websites

- Dumfries & Galloway Wildlife Festival www.wildlifefestival.org.uk
- Galloway Kite Trail www.gallowaykitetrail.com
- VisitScotland Sustainable Tourism Unit www.greentourism.org.uk

6.2 Advisory Organisations

- Wild Scotland 01463 723013 www.wild-scotland.org.uk

GEODIVERSITY

Objective 8: Highlight the geological diversity of Dumfries & Galloway, and its close relationship to biodiversity.

Priority Action (GS1): Identify the extent and location of geodiversity resources in Dumfries & Galloway, including the selection of key regional sites for protection.
Target: Set-up a database of protected and other important geological and geomorphological sites. Identify at least 10 regionally important sites by 2012.
Lead: Dumfries & Galloway Environmental Resources Centre.
Priority Action (GS2): Raise awareness and promote understanding of geodiversity among identified audiences.
Target: Promote geodiversity in at least 5 publications by 2015.
Lead: Scottish Natural Heritage.

1. Background

Geodiversity is short for geological diversity and includes the whole range of earth heritage topics. It is the variety of rocks, minerals, fossils, landforms, sediments and soils, together with the natural processes that form and alter them.

The part played by geodiversity in shaping our environment extends far beyond the physical landform. The region's biodiversity is directly dependant on earth processes, the character of the exposed rocks, and the soils that derive their characteristics from the underlying solid geology or deposits. In some cases there are obvious links between geodiversity and biodiversity – sea cliffs only form in the appropriate geological conditions, and blanket bogs are clearly dependent on the underlying soil type. In many other habitats biodiversity is more influenced by factors such as latitude, altitude, slope, aspect, climate, and past and present site management, but many of these are also influenced by geodiversity.

The oldest rocks known in Dumfries & Galloway are from the Ordovician and Silurian periods, between 495 and 418 million years ago. At this time southern Scotland was part of a deep ocean, known to geologists as the Iapetus Ocean. On the northern edge of this ocean was a continental plate, known as Laurentia, while to the south was another known as Eastern Avalonia which was moving gradually northwards. Particles of sediment in the water accumulated on the ocean bed and are preserved today as Shales, Mudstone, Siltstone, Greywacke and Conglomerates. The Iapetus Ocean closed and the two continents eventually collided. As the ocean

Sea-sculptured sandstone at Barlocco. (Richard Mearns)

floor was forced under the northern continent some of it was scraped off, folded and stacked to form a new mountain chain across what is now the Southern Uplands.

When the ocean floor was forced down beneath the continent it caused melting of parts of the crust. Giant blobs of molten rock were trapped deep beneath the surface and slowly cooled and solidified to become

Folded rocks at Ravenshall, July 2007. (Peter Norman)

huge pockets of granite. This granite was to have an influence on the formation of mineral deposits in Dumfries & Galloway.

By the Carboniferous Period, around 340 million years ago Dumfries & Galloway has moved to a position near the equator and lay on the edge of a wide tropical sea. The low lying basins went through repeated cycles of changing conditions from shallow seas to swampy forests and back again. In the clear, warm water beds of limestone accumulated while periodic influxes of sand and mud deposited by deltas building from a landmass to the north formed mudstones and sandstones. The remains of the swampy forests are preserved today as the coal seams of the Coal Measures.

By about 260 million years ago, during the Permian Period, Dumfries & Galloway lay within tropical latitudes and became an arid desert. Giant shifting sand dunes developed and were to become red sandstones. With the onset of Triassic times, about 210 million years ago, the region was still hot and dry but seasonal heavy rains would wash the sand into low lying areas to become layers of sandstone.

There is little further evidence for the region's geological evolution until the glacial periods. Over the last 1.6 million years ice has reshaped the old landscape and created the one we recognise today. Ice sheets hundreds of metres deep fed glaciers that flowed under their own enormous weight. They gouged out valley bottoms and scoured off layers of rock to expose those below. When the ice melted it left the rock debris it was carrying including large boulders have been dumped, sometimes far from their place of origin.

Geodiversity is present across the whole of Dumfries & Galloway but is most apparent in locations where geological deposits and features may be experienced. Local interest extends from granite pavement and moranic deposits in the Merrick Kells to salt marsh in the Upper Solway Flats and Marshes and from significant fossils at Dob's Linn to the complex beach and dune system at Torrs Warren.

2. Environmental, Economic and Social Importance of Geodiversity

- Quarrying of local building stone has contributed to local distinctiveness. The character of towns such as Creetown, Dalbeattie, Dumfries and Annan is very much defined by local granites and sandstones.
- The geology of Dumfries & Galloway has yielded a wealth of minerals and fossil fuels that have been worked for generations. The majority of the mining activities were of a small scale and of intermittent duration but have left a legacy in today's landscape including habitats associated with spoil and slag heaps.
- The total living matter in a hectare of soil ranges from 6,000 to 22,000kg (equivalent to 150-550 sheep). There are up to 10,000 different species of bacteria in one gram of soil, representing more genetic diversity than all the plants, mammals and birds in the whole of Scotland.
- Soils reduce the speed that rainwater reaches watercourses, filtering it in the process, thereby reducing flood risk and improving water quality.
- Scottish soils, especially peat, are rich in carbon and the adoption of sustainable practices that preserve or enhance this carbon sink is important. Carbon can remain stored in soils for years or may be quickly released back into the

atmosphere depending predominantly on how the soil is managed. Activities that contribute to loss of carbon from soils include deforestation, intensive cultivation and drainage of wetland and peatland.

3. Factors affecting geodiversity

- There are no identified **sites of local geodiversity importance**. In some other regions, voluntary groups have made audits of geological sites and features and have selected key sites (known as Regionally Important Geological and geomorphological Sites or RIGS) for protection. These are selected by locally developed criteria and are currently the most important places for geology and geomorphology outside statutorily protected land.
- **Climate change** may result in: warmer temperatures that increase loss of organic matter from soils; increased rainfall that leads to greater erosion, especially of upland peats that store carbon; and sea level rise that increases coastal erosion.
- There is evidence from England and Wales that **soil organic matter** is being lost, which will have serious affects on soil ecosystem services.
- Average **carbon content of soils** appears to be dropping. In England and Wales this has been estimated as 0.6% (4 million tonnes) per year. Soil that is sealed under built structures loses all its ecosystem functions.
- **Soil contamination** from atmospheric nitrogen and heavy metals can impact on soil fertility and biodiversity.

4. Recent and current activity

- A voluntary geodiversity group, GeoD, was formed in Dumfries & Galloway in 2008.
- Nationally important geological and geomorphological sites are protected as Sites of Special Scientific Interest (SSSIs) and represent the basis for site based conservation in Scotland. These were selected through the Geological Conservation Review (GCR), a site based audit of Britain's geological and geomorphological resource. The review identified 45 sites in Dumfries & Galloway, and range from natural outcrops and coastal cliffs to artificial sites such as quarries, pits, and road and rail cuttings.
- A geological trail in upper Nithsdale has been established by Kirkconnel Parish Heritage Society.
- A number of museums raise awareness of the importance of geodiversity.

5. Other recommended actions

- Secure resources to establish a site **monitoring system for geological and geomorphological sites**.
- Undertake an **audit of existing geodiversity information**.
- Carry out a **systematic survey** to identify potentially important examples of local geodiversity.
- **Review existing policy documents** from local authorities and targeted organisations to determine whether appropriate policy(ies) to safeguard geodiversity already exist.
- Identify sites with potential for **self guided walks and geological trails**.
- Identify potential locations for **on-site interpretation**.
- Identify potential locations for formal **education** or community led study.

6. Further Information

6.1 Publications

- Greig, D C. (1971) British Regional Geology: the south of Scotland. Her Majesty's Stationary Office, Edinburgh.
- Stone, P (ed). (1996) Geology in south-west Scotland: an excursion guide. British Geological Society. Keyworth, Nottingham.

6.2 Websites

- British Geological Survey www.bgs.ac.uk
- Scottish Geology www.scottishgeology.com
- The Geological Society www.geolsoc.org.uk
- The Macaulay Institute www.macaulay.ac.uk

RELATED STRATEGIES

Objective 9: Biodiversity incorporated into relevant strategies in Dumfries & Galloway.

Priority Action (RS1): Incorporate biodiversity objectives into all other relevant plans and strategies within the lifetime of this plan.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Background

Biodiversity is not confined to nature reserves or designated sites, but can be impacted on, or enhanced, anywhere in Dumfries & Galloway by virtually any human activity. Therefore, in addition to plans, programmes and strategies relating specifically to biodiversity, it is important to incorporate biodiversity objectives into all strategies where there may be a significant link.

The Strategic Environmental Assessment (SEA) regulations came into force under the Environmental Assessment (Scotland) Act 2005. These require completion of a systematic method for assessing the environmental effects of plans and programmes during their preparation, allowing for the mitigation of any adverse effects before plan implementation. Indeed this LBAP has itself been subject to the SEA process. The SEA process includes biodiversity as a key issue and presents an opportunity to reach a wider range of biodiversity stakeholders.

Neither does biodiversity respect political boundaries and it is important to ensure co-ordinated action across borders. In Dumfries & Galloway, this is particularly important for marine and upland habitats, and to a lesser extent riverine habitats, which are the ones that most commonly straddle administrative boundaries.

2. Environmental, Economic and Social Importance of Biodiversity

- Ensuring biodiversity and other environmental matters are included in economic and social plans, programmes and strategies contributes towards ensuring sustainable development.

3. Recent and current activity

- The Dumfries & Galloway LBAP is already specifically referred to in a number of local land-use strategies, including the Dumfries & Galloway Structure Plan, Local Forest Frameworks, Catchment Management Plans, National Scenic Area Management Strategies, Shoreline Management Plan, and Shellfish Management Plan.

4. Other recommended actions

- Focus attention on making LBAP actions relevant to **education and health sectors**, and others that do not relate mainly to land-use, such as community planning.
- Where possible, encourage specific **LBAP policies and objectives** in related local strategies, rather simple references to the LBAP.
- Prepare a **Supplementary Planning Guidance** note on biodiversity.
- Ensure LBAP objectives are adequately considered in **Environmental Impact Assessments**.
- Establish regular liaison with **adjacent LBAPs** in Ayrshire, South Lanarkshire, Scottish Borders and Cumbria.

SUBTIDAL ROCK

Priority Action (SR1)

Improve knowledge of the biodiversity importance of subtidal rock habitats in Dumfries & Galloway.
Lead Partner: Scottish Natural Heritage.

1. Habitat Description

1.1 Physical Characteristics

The type of bedrock in subtidal rock habitats has less of an influence on biodiversity than in terrestrial habitats, as food and nutrients are supplied in the seawater, the rock providing little more than an anchorage. However, the strength of the tidal streams and the exposure to wave action are major influences on the biodiversity of subtidal rock habitats, particularly in shallow areas. They influence the turbidity of the water, the quantity of food carried in suspension and the levels of oxygenation. The nature of the rock surface can therefore be important, with a surface cut by **gullies and crevices** supporting a wider range of environmental conditions and much more diversity than unbroken bedrock. The rocky walls of surge gullies in particular support rich invertebrate communities.

Dense aggregations of Oaten Pipe Hydroids Tubularia indivisa are found on rock faces exposed to strong currents. (Paul Naylor)

The depth of water above subtidal rock governs the degree of light penetration and therefore also has a significant influence on biodiversity. Well-lit **rock surfaces in shallow water** are dominated by seaweeds, but **rock surfaces in deep water** are colonised by a range of encrusting animals. **Reefs** are usually associated with tropical corals, but in certain circumstances colonies of temperate water marine animals can form reefs, which may provide a habitat for other species. The **open water** above subtidal rock supports many species.

1.2 National and International Context

Subtidal rock in the UK tends to occur around headlands, fringing islands and in rocky inlets. Most of the UK's inshore areas, including most of those off Dumfries & Galloway, are dominated by soft sediments.

2. Dumfries & Galloway Status

2.1 Recent Trends

Subtidal rock habitats are generally robust, with no evidence of significant damage in Dumfries & Galloway. Climate change and fishing, including shellfish dredging over reefs, may have affected species composition, but little monitoring has been carried out.

2.2 Current Distribution

Subtidal rock exposures occur along the Solway between Auchencairn Bay and Mull of Galloway and along the west coast of the Rhins. The rocky seabed to the west of the Isle of Whithorn is richest in biodiversity. To the east it is restricted to a shallow fringe around the coast

2.3 Site Examples

The deepest area of subtidal rock (and other sediments) is the **Beaufort's Dyke** in the North Channel. This trench is up to 302m deep, about 50km long and 3.5km wide. Particularly important subtidal rock communities are found around the **Mull of Galloway** (SAC/SSSI) and **Scare Rocks** (SSSI), where this habitat extends to a depth of 20m. It also occurs at the mouth of **Loch Ryan** (MCA). A number of wrecks provide a habitat similar to shallow subtidal rock, most notably the wreck of 'The Jasper' in **Wigtown Bay**. *Sabellaria spinulosa* reefs are found in a few locations, most frequently around **Burrow Head**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with subtidal rock, and the following action plans may also contain relevant information:

Subtidal Sands and Gravels, Subtidal & Intertidal Scar Grounds, Honeycomb Worm Reefs, Intertidal Rocky Shores.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

To the west of the Isle of Whithorn tunicates and sponges dominate the seabed community. On **rock surfaces in deep water** where there is insufficient light for algae to grow, the sponge *Amphilectus fucorum* may cover up to 30% of the rock surface. Other typical species include Oaten Pipe Hydroid *Tubularia indivisa* and Elephant's Ear Sponge *Pachymatisma johnstonia*.

At Burrow Head the boulder habitats and **rock surfaces in shallow water** are current swept and dominated by sea squirts and important reefs of the polychaete worm *Sabellaria spinulosa*. These solid, but fragile, reefs are several centimetres thick and raised above the surrounding seabed. They provide a habitat that allows many other species to become established. There are also dense stands of the bryozoans Hornwrack *Flustra foliacea* and *Bugula plumosa* and populations of Rosy-feather Stars *Antedon bifida*.

Rosy-feather Stars Antedon bifida are abundant in some locations. (Paul Naylor)

Many species of crab and the Common Lobster *Homarus gammarus* take refuge in **gullies and crevices**, emerging to feed at night. The uncommon Brown Sea-cucumber *Aslia lefevrei* has been recorded from crevices in bedrock at the entrance to Loch Ryan and the crevice-dwelling Daisy Anemone *Cereus pedunculatus,* uncommon in Scotland, has also been recorded at one site in Loch Ryan.
To the east of the Isle of Whithorn the fauna is less diverse and erect bryozoans and hydroids dominate.

3.2 Fishes (high importance)

Fishes such as Tompot Blenny *Parablennius gattorugine* and Conger Eel *Conger conger* find shelter in **gullies and crevices** of subtidal rock. The fearsome looking Wolf Fish *Anarhichas lupus* occurs in a similar habitat, usually only in deeper waters. Other demersal (bottom dwelling) fish include Greater Spotted Dogfish *Scyliorhinus stellaris,* commercial species such as Cod *Gadus morhua* and Haddock *Melanogrammus aeglefinus,* Ballan Wrasse *Labrus bergylta* in shallow water and young Pollack *Pollachius pollachius* amongst seaweeds.

Tompot Blenny (on sponge), a common inhabitant of rock crevices and wrecks. (Paul Naylor)

Amongst many **open water** (pelagic) fishes are Atlantic Herring *Clupea harengus* and Mackerel *Scomber scombrus.* Basking Sharks *Cetorhinus maximus* are sometimes recorded during the summer.

3.3 Mammals (high importance)

Harbour Porpoises *Phocoena phocoena* and Bottlenose Dolphins *Tursiops truncatus* are regularly recorded in **open waters** around the Rhins of Galloway, along with smaller numbers of Minke Whales *Balaenoptera acutorostrata*, Common Dolphins *Delphinus delphis* and other cetaceans.

3.4 Birds (medium importance)

A number of fish-eating birds feed in the **open waters** above subtidal rock, including Gannets *Morus bassanus*, Guillemots *Uria aalga*, and Razorbills *Alca torda.*

3.5 Non-flowering Plants (medium importance)

Rock surfaces in shallow water are dominated by kelp forests, which form a transition between subtidal and intertidal rocky shores. These consist

of a range of brown seaweeds, including Oarweed *Laminaria digitata*, Sugar Kelp *Saccharina latissima* and Dabberlocks *Alaria esculenta*. Many, smaller, red seaweeds find refuge amongst the kelp. The Bootlace Weed *Chorda filum* occurs in Drummore Bay, where it is sheltered from excessive wave exposure.

Kelp thins out with increasing depth and red algae dominate; *Rhodochorton purpureum* is a common species of **crevices**. *Drachiella heterocarpa*, a small red seaweed confined to the subtidal zone of wave-exposed coasts, particularly subtidal cliffs, has an extremely limited western distribution in Britain with few Scottish records. It occurs at Burrow Head. On **rock surfaces in deep water** seaweed may be absent altogether.

3.6 Reptiles and Amphibians (low importance)

Marine turtles such as the Leatherback *Dermochelys coriacea* and Loggerhead *Caretta caretta* feed in **open water** over subtidal rock during part of their annual migrations.

3.7 Fungi (low importance)

Fungi are well represented in marine environments but virtually all are microspecies. Nevertheless, several species associated with seaweed are likely to play a role in the ecology of subtidal habitats.

4. Environmental, Economic & Social Importance of Biodiversity

- Inshore fishing, using both static and mobile equipment, in waters above subtidal rock habitats is economically important to some coastal communities.
- Sea angling for species associated with this habitat is of recreational importance for a large number of people, and therefore of economic importance.

5. Factors affecting the Habitat

- A **lack of knowledge** of species and habitats present, due to limited research and surveys.
- Very little **statutory protection**, even in designated sites.
- Beaufort's Dyke and surrounding waters were used as a **munitions disposal** site during the 20th century, with significant quantities dumped after the two world wars and the last dumping in 1976. Surveys have not shown contamination of seabed sediments or commercially exploited fish and shellfish.
- **Bottom fishing gears**, though rarely deployed in rocky areas, can damage fragile communities.
- **Marine litter** can kill some species which ingest it or become tangled in it. Lost fishing gear may continue to catch fish ("ghost fishing").
- Discharge of contaminants and nutrient enrichment from **run-off and sewage**, or even **ship-based pollution**, can result in localised changes to seabed communities.
- **Dumping of spoil** from dredging operations or coastal development work would seriously damage subtidal rock habitats.
- **Recreational diving** has the potential to result in minor localised damage. This is not likely to apply to Dumfries & Galloway where diving conditions over most areas are highly dangerous for all but the most experienced divers.

6. Strategic Actions

6.1 Recent and current activity

- Schemes of Management have been prepared by **Solway Firth Partnership**, on behalf of SNH for The Solway and Luce Bay & Sands SACs. These include some areas of reef, and SNH is undertaking broadscale habitat mapping of Luce Bay.

6.2 Other recommended actions

- **Assess the distribution and biodiversity importance** by collating existing information and identifying known locations for subtidal rock habitats.
- **Protect** from potentially damaging activities. In other parts of the UK this has been achieved through marine nature reserves and voluntary codes of conduct.
- Undertake **research and survey work**, including promotion of the Marine Conservation Society's Seasearch programme.
- **Raise awareness** of the biodiversity of subtidal rock habitats to generally benefit marine conservation issues.

SUBTIDAL SANDS & GRAVELS

Priority Action (SSG1)

Assess the distribution and biodiversity importance of subtidal sand and gravel habitats in selected areas by collating and making available existing information.
Lead Partner: Scottish Natural Heritage

1. Habitat Description

1.1 Physical Characteristics

Subtidal sands and gravels are derived either from shells, as in most of the west of the UK, or from bedrock, as in the North Sea. Although often extensive in area, they usually form only thin **sand banks** and **gravel banks** above the bedrock, glacial drift or mud. Their stability, and therefore much of their biodiversity, is greatly influenced by particle structure, the strength of tidal currents and the degree of exposure to wave action.

Horse Mussel beds form at depths of 5-70m. They may carpet steep rocky surfaces, but are more frequent in gravels, muds or mixed sediments. Individual mussels are frequently 25 years old or more and the best examples of beds are raised up by a metre or more above the surrounding seabed.

The **open water** above subtidal sands and gravels also supports many species.

1.2 National and International Context

Sands and gravels are the most common sediments found on UK seabeds. The Solway is dominated by fine sandy sediments, but does include some areas of subtidal gravel.

2. Dumfries & Galloway Status

2.1 History

Fish and shellfish have been harvested around the coasts of Dumfries & Galloway for hundreds of years.

2.2 Recent Trends

Commercial shellfishing, particularly for Scallops and Queen Scallops, has become the main fishing activity since the mid-20th century, which has had a significant impact on habitat quality. Improvements to boats and fishing gear have generally increased efficiency and catching capacity, though landings have declined since the late 20th century.

2.3 Current Distribution

Subtidal sands and gravels are most extensive in the inner Solway but also occur in the outer Solway and Loch Ryan. Small Horse Mussel beds are found in a few places on the Wigtownshire coast.

2.4 Site Examples

Subtidal sand banks are extensive throughout the **inner Solway** (SAC/SPA/Ramsar/SSSI) and are unusually dynamic, separated by the six main river channels which are continuously changing their patterns of erosion and accretion. Subtidal sands and other sediments also occur in the outer Solway, especially in **Luce Bay** (SAC). Sediments in **Loch Ryan** (MCA) grade from clean sands and gravel in the mouth to mixed sediments and mud in the sheltered central and very sheltered inner basin. Horse Mussel beds are found at **Burrow Head** and **Loch Ryan** (MCA).

Common Cuttlefish, a master of colour-change camouflage. (Paul Naylor)

2.5 Associated Habitats

A number of habitats occur in close association and/or overlap with subtidal sands and gravels, and the following action plans may also contain relevant information: Subtidal Rock, Subtidal & Intertidal Scar Grounds, Seagrass Beds, Intertidal Sand and Mud Flats.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Due to the dynamic nature of the **sand banks** in the inner Solway, few invertebrates are found within or on them other than small polychaete worms and amphipods. Numbers of species increase towards the outer estuary, in the silty areas between Castlehill Point and Wigtown Bay, with the bivalve molluscs *Fabulina fabula*, *Nucula sulcata* and *Abra alba*. In Luce Bay the variety of sediments and the sheltered environment leads to a much richer invertebrate fauna. This includes Sand Brittlestars *Ophiura ophiura*, Sand-burrowing Brittlestars *Amphiura brachiata*, Sand Stars *Astropecten irregularis,* Burrowing Heart Urchins *Echinocardium cordatum*, and Masked Crabs *Corystes cassivelaunus.* Common Cuttlefish *Sepia officinalis* lie buried in the sand during the day but emerge at night to search for prey. They spawn gregariously on shallow sandy bottoms.

Commercially exploited shellfish include Great Scallops *Pecten maximus* and Queen Scallops *Aequipecten opercularis* in firm sand and gravel. In Loch Ryan there is one of the largest beds of Native Oyster *Ostrea edulis* found in Britain, if not the world. Brown Shrimps *Crangon crangon* are abundant throughout the Solway, but mainly fished to the east of Hestan Island. They are a vital component in the ecology of the Solway Firth.

The Solway is an important summer feeding area for Basking Sharks. (Paul Naylor)

Loch Ryan supports a number of other uncommon invertebrates, most notably Gravel Sea Cucumber *Neopentadactyla mixta* found in coarse **gravel banks** at the entrance to the loch and Chinaman's Hat Shell *Calyptraea chinensis*, associated with the oyster beds.

Hundreds of species, including sponges, soft corals, anemones, hydroids, tubeworms, brittlestars, urchins, starfish, barnacles, and crabs may occur on dense Horse Mussel *Modiolus modiolus* beds, depending on depth, degree of water movement, substrate, and mussel density.

Gravel Sea Cucumber Neopentadactyla mixta is uncommon in Scotland. (Paul Naylor)

3.2 Fishes (very high importance)

Lesser Sand Eels *Ammodytes tobianus* shoal in shallow open waters above subtidal sand and are an extremely important food for many seabirds and fish. Commercial fish include: Plaice *Pleuronectes platessa*, the most commonly caught flatfish in the Solway, on muddy bottoms; Common Soles *Solea solea*, widespread on soft muddy ground; Flounders *Pleuronectes flesus* on the surface of mud and sand banks including brackish waters; and small numbers of Haddock *Melanogrammus aeglefinus* on hard, coarse sand banks.

Lesser Spotted Dogfishes *Scyliorhinus caniculus* are relatively common on sandy or muddy grounds, feeding at night, but the largest dogfish is the shark-like Tope *Galeorhinus galeus*, also found in inshore waters over sand and gravel in summer, but only in deeper water in winter. There is some evidence from local anglers of a substantial decline in this species. Basking Sharks *Cetorhinus maximus* sometimes move into quite shallow waters over subtidal sand during the summer, in pursuit of plankton shoals.

3.3 Birds (very high importance)

The waters of the region's bays and estuaries support enormous numbers of birds, especially during the winter. The following are of national importance: Red-throated Diver *Gavia stellata* in Loch Ryan, Great

Crested Grebe *Podiceps cristatus* in the inner Solway and Loch Ryan, Slavonian Grebe *Podiceps auritus* in Loch Ryan, Cormorant *Phalacrocorax carbo* in the inner Solway, Eider *Somateria mollissima* in Loch Ryan, Common Scoter *Melanitta nigra* in the outer Solway, Scaup *Aythya marila* in the inner Solway, Rough Firth and Loch Ryan, and Red-breasted Merganser *Mergus serrator* in the inner Solway and Loch Ryan. Numbers of Scaup in Dumfries & Galloway (over 3,300 each year between 1999 and 2004) are particularly notable, making the region by far the most important British area for this species.

3.4 Mammals (medium importance)

Harbour Porpoises *Phocoena phocoena* are regularly seen throughout the Solway. Small numbers of Grey Seals *Halichoerus grypus* are also recorded.

3.5 Reptiles and Amphibians (medium importance)

Marine turtles in Scottish waters were once thought to be infrequent wayward wanderers, but it is now believed that Leatherback Turtles *Dermochelys coriacea* regularly visit the Solway in late summer and autumn as part of their annual migration. Loggerhead Turtles *Caretta caretta* are also sometimes recorded.

3.6 Non-flowering Plants (low importance)

Although subtidal sands and gravels generally do not have extensive seaweed communities some species do occur, including a nationally rare red seaweed *Spyridia filamentosa* that reaches its northern limit and is locally common in Loch Ryan. It is found throughout the loch, particularly in the southern basin. Another red seaweed *Chondria dasyphylla,* rare in Scotland, grows on **gravel banks**, pebbles and shells in Loch Ryan. The common red seaweed *Rhodothamniella floridula* binds coarse sand into **sand banks**.

3.7 Fungi (low importance)

A number of fungal microspecies are associated with seaweeds and fish.

4. Environmental, Economic & Social Importance of Biodiversity

- Scallop fishing and processing is an important local industry.
- Loch Ryan supports the largest Native Oyster fishery in Scotland.
- Sea angling for species associated with this habitat is of recreational importance for a large number of people, and therefore also of economic importance.

Great, or King, Scallops Pecten maximus excavate their own hollows in sand or gravel beds. (Paul Naylor)

5. Factors affecting the Habitat

- Disturbance from **bottom-fishing** gear.
- Potential pollution from future aquaculture activities, and **chemical and sewage discharges**, both directly and via inflowing rivers.
- **Radioactive discharges** from Sellafield and Chapelcross, and the firing of over 6000 depleted uranium projectiles into the Solway by the Ministry of Defence may have some impact, though this is not proven.
- **Oil spills and ballast water** from shipping. Also TBT (tri-butyl tin) has been used as an anti-fouling paint on ships and leisure craft since the 1980s. It has affected the reproductive capacity of molluscs, including Native Oysters.
- High levels of **suspended sediment** in Loch Ryan detrimentally affects Native Oysters and other shellfish.
- **Sea-borne litter**, especially plastic bags and balloons (often released in large numbers as part of charity events) are ingested by marine turtles in mistake for jellyfish, frequently leading to their death.
- Offshore developments such as **wind turbines, aggregate extraction** and the laying of **undersea pipelines and cables** may pose a threat to some species.

- **Dumping of dredging spoil** may smother important habitats.
- **Non-native invasive species** such as Wireweed *Sargassum muticum* and Leathery Sea-squirt *Styela clava* have been recorded in Loch Ryan. Others such as the American Oyster Drill *Urosalpinx cinerea* and the Slipper Limpet *Crepidula fornicata* may potentially spread to Dumfries & Galloway in the future. All can reduce native species.

Masked Crab, common on sandy seabeds. (Paul Naylor)

6. Strategic Actions

6.1 Recent and current activity

- Loch Ryan's marine environment was recognised in 1990 when it was designated as a **Marine Consultation Area** (MCA) following a survey carried out by the Marine Nature Conservation Review Survey. This is a non-statutory mechanism for site protection that recognises the quality and sensitivity of the marine environment.
- Schemes of Management have been prepared by **Solway Firth Partnership**, on behalf of SNH, for The Solway and Luce Bay & Sands SACs.
- **Scottish Natural Heritage** is undertaking broadscale habitat mapping of Luce Bay.
- The **Solway Firth Partnership** and **Loch Ryan Forum** bring user groups together to discuss management issues.
- Monthly bird counts and annual beached bird surveys are undertaken on most sites during the winter.
- The commercial significance of Loch Ryan's oyster population provides a mechanism for monitoring the water quality and general health of the loch's coastal waters through the **Marine Laboratory** in Aberdeen and by SEPA.
- Upgrading of Stranraer sewage treatment works has taken into account the biodiversity of Loch Ryan.
- TBT has been banned and use is being phased out.

6.2 Other recommended actions

- **Maintain high water quality** from direct and indirect discharges or run-off.
- **Guide inappropriate development** away from sensitive sites or the adjacent coastal land to reduce damage to benthic communities and species, especially where they are particularly fragile, vulnerable or unusual. Where this has already occurred examine the feasibility of re-establishment or restoration.
- **Agree codes of practice** between conservationists and ferry operators that minimise impacts on biodiversity from ferries.
- Implement Schemes of Management for **European Marine Sites.**
- Examine the potential of Loch Ryan to qualify for **higher level designation** than Marine Consultation Area.
- **Promote and highlight the value** of the marine wildlife resource.

SUBTIDAL & INTERTIDAL SCAR GROUNDS

Priority Action (SISG1)

Ensure that the biodiversity importance of subtidal and intertidal scar grounds is taken into account in decision-making by ensuring that they are included in all relevant coastal strategies.
Lead Partner: Dumfries & Galloway Council

1. Habitat Description

1.1 Physical Characteristics

Scar grounds are intermediate between rocky and sandy seabeds and occur in both subtidal and intertidal situations. They consist of coarse sediments such as pebbles, cobbles and boulders that are raised above the level of surrounding sandy seabed. Low-lying scar ground may be periodically covered or scoured by sand, with only brief periods of exposure and colonisation by marine life before being covered by sand again. Colonisation is influenced by the time of year when the rock becomes exposed, as the spawning and recruitment of many marine plants and animals is seasonal. Other areas away from periodic inundation by sand support greater biodiversity.

1.2 National and International Context

Subtidal scar grounds occur throughout the world. Substantial areas are found off the coast of British Columbia in Canada and the west coast of Scotland.

Dahlia anemone Urticina felina, a colourful inhabitant of offshore scar grounds. (Paul Naylor)

Common Mussels Mytilus edulis often occur in large numbers on scar grounds. Mossyard. (Peter Norman)

2. Dumfries & Galloway Status

2.1 Recent Trends

There does not appear to have been any significant change in the extent or distribution of scar grounds in recent years.

2.2 Current Distribution

Scar grounds are more common on the English side of the Solway. On the north side, this habitat has a patchy distribution.

2.3 Site Examples

Examples of subtidal scar grounds are found at **Powfoot** (SAC/SPA/Ramsar/SSSI), **Southerness** (SSSI), **Hestan Rock**, **Ravenshall Point** (SSSI) in Wigtown Bay and on the east side of **Luce Bay** (SAC).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with subtidal and intertidal scar grounds, and the following action plans may also contain relevant information: Subtidal Rock, Subtidal Sands and Gravels, Intertidal Sand and Mud Flats, Honeycomb Worm Reefs, Intertidal Rocky Shores.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

The invertebrate fauna of scar grounds is often richer than surrounding muds, sands and gravels, though species composition can change rapidly over time.

Mussels on intertidal scar at Southerness. (Richard Mearns)

Early colonisers of exposed scar grounds include barnacles *Semibalanus balanoides* and *Elminius modestus*, with Common Periwinkles *Littorina littorina* arriving later. Even on scar ground exposed for longer periods, the dominant species can change rapidly. The Breadcrumb Sponge *Halichondria panicea* is typical. Others include Dahlia Anemones *Urticina felina*, Rosy-feather Stars *Antedon bifida* and Common Starfish *Asterias rubens*.

Mussels *Mytilus edulis* can vary enormously in abundance. In years following a good settlement, they may out-compete other invertebrates and seaweeds, but mussel populations may then be reduced following sand inundation.

3.2 Non-flowering Plants (high importance)

Colonisers of newly exposed scar grounds include gutweeds *Enteromorpha linza* and *E. intestinalis*, Sea Lettuce *Ulva lactua*, and Purple Laver *Porphyra umbilicalis.* Some of these may later become abundant, joined by Bladder Wrack *Fucus vesiculosus*, a brown seaweed *Fucus ceranoides*, a red seaweed *Dumontia contorta* and Carrageen *Chondrus crispus*. Many species of invertebrate are associated with these seaweeds.

3.3 Fishes (medium importance)

Common Gobies *Pomatoschistus microps* and Sand Gobies *P. minutus* may be present throughout the warmer months from May onwards.

3.4 Birds (low importance)

Due to their relatively limited distribution scar grounds do not support important numbers of birds. Nevertheless, common species such as Oystercatchers *Haematopus ostralegus* and Curlews *Numenius arquata* feed on intertidal scar grounds.

4. Environmental, Economic & Social Importance of Biodiversity

Subtidal scar grounds make a contribution to fisheries, either directly or as a source of food for commercially fished species.

5. Factors affecting the Habitat

- Physical damage of intertidal scar grounds by manual shellfish harvesting, which may be associated with disturbance from tractors and off road vehicles.
- Physical damage can result from recreational pressure, though the number of people walking over scar grounds is unlikely to be high.

Oystercatchers, regular visitors to scar grounds. (Gordon McCall)

6. Strategic Actions

6.1 Recent and current activity

- Scar grounds are protected from damage from shellfish harvesting in the **Solway Shellfish Management Association**'s management plan.

6.2 Other recommended actions

- **Map the location of all scar grounds**, survey their biodiversity importance and monitor changes.
- **Raise awareness** of subtidal and intertidal scar grounds, their location, biodiversity importance and possible threats.

INTERTIDAL SAND & MUD FLATS

Priority Action (ISMF1)

Assess the distribution and biodiversity importance of intertidal sand and mud flats in selected areas by collating existing information and increasing its availability, by 2012.
Lead Partner: Scottish Natural Heritage

Priority Action (ISMF2)

Increase knowledge of the biodiversity intertidal sand and mud flats in Dumfries & Galloway by encouraging universities to carry out research in the Solway.
Lead Partner: Solway Firth Partnership

1. Habitat Description

1.1 Physical Characteristics

Intertidal sand and mud habitats form a major component of estuaries and bays, but also occur on open coasts. They range from mobile coarse **sand flats** to fine sediment **mud flats**. Despite the fact that they often appear to show little or no conspicuous signs of life, they are extremely rich in biodiversity according to sediment type, stability and water salinity.

Nith estuary mudflats. January 2008. (Richard Mearns)

Coarse sands occur where sediments are exposed to wind and/or wave action, or where strong tidal currents prevent the deposition of silt. These banks are highly mobile and may dry out considerably at low tide. More sheltered sands offer more stable environments. Muds form in the most sheltered areas, usually where large quantities of river derived silt are deposited. They remain saturated with water but have little water exchange and often have little oxygen present in the sediment, even just below the surface. Between these extremes a wide range of sediment types exist.

Input of freshwater has a major influence on biodiversity. Most marine organisms are unable to survive in areas with variable and low salinity, so species variety generally increases with distance away from freshwater. Only a relatively small number of species have adapted to estuarine conditions, but they may occur in vast numbers.

Intertidal flats can be very mobile due to the ever-changing erosional and depositional regime and exposure to strong tidal streams and wave action. River channels are in particular subject to constant change, whilst fringing sandbanks are generally more stable.

1.2 National and International Context

About 50% of the UK coastline (9849km) is estuarine and the 163 estuaries which make up this figure represent nearly a third of the total estuarine area of the North Sea and Atlantic seaboard of western Europe. A significant proportion of the UK's sand and mud flats is found in Dumfries & Galloway, with at least 32,000ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

The harvesting of cockles rose dramatically in the 1980s and 1990s, affecting not only cockle stocks, but also the associated biodiversity of intertidal sand and mud flats. The fishery was closed to mechanical dredging in 1994 and completely closed in 2001, but a regulated fishery re-opened in 2006.

2.2 Current Distribution

Highly mobile intertidal sediment flats of fine sands, rather than muds, dominate much of the Solway. The estuary is shallow in nature, leading to considerable fluctuation in water temperature.

2.3 Site Examples

The **inner Solway** (SAC/SPA/Ramsar/SSSI) has the third largest area of estuarine intertidal flat in the UK,

covering some 26,000ha. **Rough Firth, Auchencairn Bay** (SSSI) and **Orchardton Bay** (SSSI) are predominantly composed of intertidal sand and mud flats, with around 1,150ha in total extent. A greater proportion **Kirkcudbright Bay** is constantly covered by the sea, but around 750ha of intertidal areas are also present, and a similar area in nearby **Fleet Bay**. Approximately 2,900ha of intertidal sand and mud flats are found in **Wigtown Bay** (LNR/SSSI), and 1,160ha at **Luce Bay** (SAC). **Loch Ryan** (MCA) is shallow over its entire area with an average depth of 2 to 5 metres. The southern basin of the loch includes intertidal areas with little freshwater input.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with intertidal sand and mud flats, and the following action plans may also contain relevant information: Subtidal Sands and Gravels, Subtidal & Intertidal Scar Grounds, Seagrass Beds, Coastal Sandy Beaches.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Most of the invertebrates of intertidal sand and mud flats burrow in the sediment to prevent themselves from drying out and being eaten by surface living predators such as birds and fish. They feed on other invertebrates, plants, or detritus filtered out from overlying water or within the sediment.

Empty shell of Burrowing Heart Urchin or Sea Potato Echinocardium cordatum. Torrs Warren, June 2007. (Peter Norman)

The composition of invertebrate communities varies according to the sediment type and salinity, but typical species on the Solway include the Peppery Furrow Shell *Scrobicularia plana*, the Baltic Tellin *Macoma balthica* and the Common Cockle *Cerastoderma edule*. The latter species can fluctuate widely in numbers as a result of natural processes. A single successful settlement of spat can result in densities of more than 1000 per square metre, but there can be a reduction of up to 80% during a hard winter. The Laver Spire Shell *Hydrobia ulvae* is commonest in the upper half of the intertidal zone and may occur at densities of 200,000 per square metre. The Estuary Ragworm *Hediste diversicolor* and the Lugworm *Arenicola marina* are also common.

Brown Shrimp, a crucial species in the food chains of subtidal and intertidal sandy seabeds. (Paul Naylor)

Brown Shrimps *Crangon crangon* occur at between 3-50 million shrimps over 20 square kilometres of **sand flat**, whilst in clean medium to fine sand flats, such as in the centre of Luce Bay, there are dense populations of the burrowing heart urchin *Echinocardium cordatum* and razor shells *Ensis* spp.

The nationally rare Wine-glass Hydroid *Obelia bidentata* grows up to 2.5cm long in tree-like pink colonies in intertidal areas in the inner Solway.

A few terrestrial species occur on the upper shore, especially where freshwater flows over the sediment. This includes a ground beetle *Bembidion maritimum* at its only Scottish site in Wigtown Bay.

3.2 Birds (very high importance)

The invertebrate rich sand and mud flats of the Solway support nationally and internationally important numbers of over-wintering birds. Winters are generally mild and many species spend the whole season in the area, but the region's intertidal flats are also of critical importance to birds refuelling on migration. The number of birds using the inner Solway during the winter swells to over 140,000, making the estuary the seventh most important in the UK in terms of bird numbers. Internationally important species are as follows (all in inner Solway): Shelduck *Tadorna tadorna*, Pintail *Anas acuta*, Oystercatcher *Haematopus ostralegus*, Knot *Calidris canutus*, Dunlin *Calidris alpina*, Bar-tailed Godwit *Limosa lapponica,* Curlew *Numenius arquata* and Redshank *Tringa totanus.* Barnacle Geese *Branta leucopsis* also use the sand and mud flats as night-time roosts. Nationally important species are as follows (all in inner Solway): Shoveler *Anas clypeata*, Ringed Plover *Charadrius hiaticula*, Golden Plover *Pluvialis apricaria*, Grey Plover *Pluvialis squatarola*, Lapwing *Vanellus vanellus*, Sanderling *Calidris alba* and Greenshank *Tringa nebularia.*

Plaice spend most of their time on the seabed. (Paul Naylor)

3.3 Fishes (high importance)

Sand and mud flats support fish such as the Common Goby *Pomatoschistus microps* and Flounder *Platichthys flesus* and provide an essential nursery ground for fish such as Sea Bass *Dicentrarchus labrax*, Plaice *Pleuronectes platessa*, Common Sole *Solea solea* and Atlantic Herring *Clupea harengus*. A number of pelagic species, such as the Lesser Sand Eel *Ammodytes oobianus* and mullets *Mugilidae* and are resident for part of the year, whilst others, including the scarce Sea Lamprey *Petromyzon marinus*, River Lamprey *Lampetra fluviatilis,* Allis Shad *Alosa alosa* and Twaite Shad *Alosa fallax,* migrate over sand and mud flats to their freshwater spawning grounds. The Cree estuary holds one of the very few spawning grounds for Sparling *Osmerus eperlanus* in Scotland.

3.4 Mammals (medium importance)

Harbour Porpoises *Phocoena phocoena* are frequently seen in shallow water over sand and mud flats.

3.5 Flowering Plants (medium importance)

Seagrass forms dense beds (see separate Habitat Action Plan) but few other flowering plants are able to survive in these hostile environments. A few species occur on the landward edge of sand and mud flats, including glassworts *Salicornia* spp., Common Cord Grass *Spartina anglica* and Townsend's Cord Grass *S. x townsendii.*

3.6 Non-flowering Plants (low importance)

The surface of intertidal flats may be covered with green algae such as Gutweed *Enteromorpha intestinalis* or Sea Lettuce *Ulva lactua* during the summer months. The nationally scarce brown seaweed *Sphacelaria plumigera* occurs in intertidal, often shaded, sandy pools. It has been recorded in Wigtown Bay.

3.7 Fungi (low importance)

Fungi are well represented in marine environments but virtually all are microspecies. Nevertheless, several species associated with seaweed are likely to play a role in the ecology of subtidal habitats.

4. Environmental, Economic & Social Importance of Biodiversity

- Sand and Mud Flats play an important role in coastal defence, dissipating wave energy.
- Sand and mud flats provide feeding and nursery areas for commercially exploited fish.
- Intertidal communities are directly exploited for shellfish such as cockles and shrimps, or for angling bait including lugworms and ragworms.
- Important economic benefits result from wildlife (especially bird) watching, and recreational sea angling.

5. Factors affecting the Habitat

- Creation of enclosed bays through barrages, for power generation, amenity and perceived aesthetic reasons destroys mud flats and the associated wildlife interest.
- Coastal defences could interfere with existing patterns of movement of sediments.
- Industrial and agricultural run-off or polluted storm-water discharge, including eutrophic river water, can create abiotic areas or encourage the growth of algal mats that will adversely affect invertebrate communities.
- Piping or channelling freshwater over the upper shore may remove critical invertebrate habitats.
- Intertidal fisheries such as cockling and dredging for fish can damage the seabed.
- Aquaculture has the potential to cause damage if not carefully located and managed.
- Recreational pressure, including bait digging, can in exceptional circumstances lead to depletion of certain species.
- Vehicle use over sand and mud flats at low tide affects sediment structure, influencing suitability for invertebrates and disturbing feeding birds.
- Introduction of non-native invasive species. For example Cord Grass has spread along coasts

and colonised some upper-shore mud flat areas, disrupting the ecology. Auchencairn Bay and Fleet Bay have been particularly affected.

- Sea level rise may result in insufficient mobile sediment to adjust to new tidal levels in some cases; in other circumstances erosion of mud flats may reduce their extent and quality.
- Capital and maintenance dredging for navigation has a negative impact on sediment supply and the sediment biota.

6. Strategic Actions

6.1 Recent and current activity

- A Regulatory Order for shellfishing in the Solway was introduced in 2006. Fishing effort, locations and methods are currently regulated and monitored by the Solway Shellfish Management Association under a permit system.
- The first stage of a Shoreline Management Plan was published by Dumfries & Galloway Council and SNH in 2005 as an aid to the planning of sea defences.

Cockle shells. (Richard Mearns)

- Schemes of Management have been prepared by Solway Firth Partnership, on behalf of SNH for The Solway and Luce Bay & Sands SACs. SNH is undertaking broadscale habitat mapping of Luce Bay.
- Wigtown Bay Management Committee oversees sustainable management of this site using local bylaws.
- Implementation of a Scheme of Management, prepared by SNH for the inner Solway SAC is underway, and a Scheme of Management is in preparation for Luce Bay SAC. All 'Competent Authorities' must ensure that any operations under their management do not cause disturbance or deterioration of the interest features of these European Marine Sites.
- The Wetland Bird Survey gathers information and monitors bird populations of estuaries. A study of areas important for birds roosting on the tideline was carried out on behalf of BNFL in 1993.
- Implementation of the Solway Firth Partnership's Management Strategy is in progress.

Mud flats with lugworm casts. Sandyhills Bay, June 1991. (Peter Norman)

6.2 Other recommended actions

- Ensure that development plan policies protect estuaries from coastal development and other activities that could, individually or cumulatively, cause environmental damage.
- Promote management within the framework of SACs and other coastal zone strategies that permit the natural functioning of sediment systems.
- Meet and maintain Class A (Excellent) water quality standards in all of the region's estuaries using the Scottish Environment Protection Agency Estuary Classification Scheme to monitor chemical, biological and radiological quality.
- Review current and future dredging operations to ensure minimum impact on the estuarine environment.
- Consider the value of further site protection systems outwith designated sites using mechanisms such as local sites, voluntary reserves, no-take zones and sanctuary areas.
- Ensure that all inshore fisheries operate using methods that have a minimum impact on the firth.
- Encourage collaboration between bait diggers and conservationists to establish methods for maintaining bait digging areas such that there is minimum impact on biodiversity
- Highlight the importance of intertidal habitats to decision-makers, tourism bodies and the public.
- Increase the use of information packs and marine chests in schools in association with the Solway Firth Partnership. Develop their information content for different age groups. Offer all schools education/interpretation facilities about estuaries.

SEAGRASS BEDS

Priority Action (SB1)

Assess changes in the extent and species composition of seagrass beds.
Target: Repeat the 1993-94 survey of *Zostera angustifolia* and *Z. noltii* in the Solway Firth by 2013.
Lead Partner: Scottish Natural Heritage.

1. Habitat Description

1.1 Physical Characteristics

Seagrass beds develop in the intertidal and shallow subtidal areas on sands and muds. They are found in estuaries, marine inlets and bays, and in other areas such as lagoons and channels which are sheltered from significant wave action. Three species of seagrass (also called eel grass) have been identified in the UK, though *Zostera marina* and *Z. angustifolia* are now considered to be variants of one species:

- Common Seagrass *Zostera marina* is found in fully marine situations and occasionally in estuaries, on sheltered gravel, sand or mud from Low Water Spring tide to 4m.
- Narrow-leaved Seagrass *Zostera angustifolia* is found on mud banks, creeks and estuaries from half-tide to Low Water Spring.
- Dwarf Seagrass *Zostera noltii* occurs in similar habitats to *Z. Angustifolia* but may extend to the lower saltmarsh communities around Mean High Water.

Seagrass, Rough Firth, August 2006. (Peter Norman)

Seagrass beds have higher silt content in the sediment since it is less disturbed by wave action, hence they are less adapted to physical disturbance.

1.2 National and International Context

All three species of seagrass are currently regarded as nationally scarce in the UK. In some areas of the UK seagrass beds are declining due to physical disturbance and nutrient pollution. A report on the status of seagrass in Scotland was published in 1993 covering the latest information on distribution and threats, but there is currently no estimate of the extent of these communities in Scotland.

2. Dumfries & Galloway Status

2.1 Recent Trends

Although there has only been limited recent monitoring, seagrass beds appear to have continued to expand since the 1990s.

2.2 Current Distribution

All three species of seagrass are present in Dumfries & Galloway, recorded from seven 10km squares between 1831 and the present. Work during 1993-94 on the Dumfries & Galloway populations of the Solway assessed the occurrence and abundance of the two intertidal species (*Z. noltii and Z. angustifolia*). Approximately 5 square km (500ha) of seagrass at a variable density was recorded during the survey, but this did not include Loch Ryan. No recent survey has been carried out in the region for the subtidal *Z. marina*.

2.3 Site Examples

Beds of *Zostera marina* occur on the extreme lower shore and in shallow subtidal areas, for example at **Loch Ryan** (MCA) on sheltered fine or muddy sands. *Zostera noltii* is found at **Manxman's Lake** in Kirkcudbright Bay, around **Rough Island** in Rough Firth, in **Auchencairn Bay** (SSSI), in **Fleet Bay** and at **Baldoon Sands** in Wigtown Bay (LNR and SSSI). *Zostera angustifolia* occurs in many of the same locations in Kirkcudbright Bay, Rough Firth and Auchencairn Bay. Seagrass beds have also been recorded in the Nith Estuary.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with seagrass beds, and the following action plans may also contain relevant information: Intertidal Sand and Mud Flats.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Apart from the three species of seagrass themselves, no other flowering plants are associated with this habitat. However, the three species of seagrass are the only marine flowering plants found in Britain and they cannot be found in any other habitat.

3.2 Invertebrates (high importance)

The invertebrate fauna of seagrass beds typically consists of those species associated with the particular sediment type, but the roots of the seagrass increases stability of the sediments and provides shelter and attachment for a number of species.

Seagrass provides an important nursery area for shrimps and, in some areas, cephalapods such as Common Cuttlefish *Sepia officinalis*. Various invertebrates take refuge and sometimes breed on and around seagrass leaves, including Snakelocks Anemones *Anemone viridis,* Harbour Crabs *Liocarcinus depurator*, Sea Hares *Aplysia punctata,* and Netted Dog Whelks *Hinia reticulata.* Invertebrates in the surrounding sediment include Common Cockles *Cerastoderma edule*, Common Periwinkles *Littorina littorea*, Lugworms *Arenicola marina*, and Sand Mason Worms *Lanice conchilega*. A dense seabed fauna of non-selective deposit feeders is usually present in *Z. noltii* beds.

Sea Hares Aplysia punctata (mating trio) graze amongst seagrass beds. (Paul Naylor)

3.3 Fishes (medium importance)

Adult pipefish *Syngnathus* spp. and various species of goby make use of the shelter provided by seagrass beds. Seagrass beds provide important nursery areas for Plaice *Pleuronectes platessa* and Common Soles *Solea solea*.

3.4 Birds (medium importance)

Seagrass provides an important source of food for wildfowl such as Wigeons *Anas penelope* and Brent Geese *Branta bernicla,* though the latter species only occurs in small numbers in the region at Loch Ryan.

3.5 Non-flowering Plants (low importance)

The green seaweeds *Pringsheimiella scutata* and *Epicladia perforans* are epiphytic on seagrasses and other seaweeds.

4. Environmental, Economic & Social Importance of Biodiversity

- Seagrass beds are generally regarded as valuable and important habitats because productivity is high and large amounts of organic material are contributed to the surrounding areas. This increases food and nutrient levels for other organisms.
- Seagrass binds mud and sand, reducing erosion and encouraging deposition of suspended material. In some areas, the sediment is raised above the general level, such that in the subtidal areas, waves break further offshore, thus sheltering the adjacent beach. In intertidal areas, the raised level may decrease erosion of the fragile habitats, including saltmarsh, higher up the shore.

5. Factors affecting the Habitat

- Physical damage from **shellfish harvesting** by suction or clam dredges has been recorded in Rough Firth and Auchencairn Bay, manual gathering of shellfish in the same locations, and bait digging in Wigtown Bay. The most dramatic effect of hydraulic suction dredging was reported in Auchencairn Bay when the complete disappearance of *Zostera marina* was recorded from the dredged areas.

Greater Pipefish make use of the shelter provided by seagrass beds. (Paul Naylor)

- **Construction of pipelines** can directly impact on seagrass beds, though none are known to have so far affected beds within Dumfries & Galloway.
- Coastal engineering projects such as **flood and sea defence works**, **dredging** of harbours and navigation channels, and **land reclamation** can damage seagrass beds and cause changes in depth, turbidity and current regimes. Only minor operations have so far occurred within the region, none of which are known to have affected local beds.
- A **wasting disease** caused by slime moulds is believed to have affected local seagrass beds in the 1930s, especially in Wigtown Bay. It has been reported more recently in some parts of the UK, though there is currently no evidence of its return to Dumfries & Galloway.
- Domestic **sewage discharges** and **agricultural run-off** is high in nitrate levels and may reduce seagrass biomass whilst increasing epiphytic plankton and phytoplanktonic blooms. Most of the beds in Dumfries & Galloway are in locations with high water quality. The *Z. noltii* beds in Wigtown Bay below Orchardton Farm are thought to be beneficially affected by agricultural run-off.
- The extent of seagrass beds may alter as a result of natural factors such as severe **storms, exposure to air, freshwater pulses**, or the seasonal effects of **wildfowl grazing**. In Dumfries & Galloway, these factors are not considered significant.
- **Warmer sea temperatures** as a result of global warming, coupled with low levels of sunlight, may cause significant stress and dieback of seagrass.
- Seagrass is known to accumulate tributyl tin and possibly some other **marine pollutants**, which may reduce nitrogen fixation in the plant and possibly cause a build up of pollutants in the food chain. There is no evidence to suggest that local seagrass beds have been affected.
- Colonisation of intertidal muds by **invasive cordgrass** *Spartina anglica* has occurred in parts of Wigtown Bay, Fleet Bay, and Auchencairn Bay but has not so far impacted on seagrass beds.

6. Strategic Actions

6.1 Recent and current activity

- The Loch Ryan non-statutory Marine Conservation Area is in place to promote consultation and conservation safeguards.
- The **Solway Firth Partnership, Wigtown Bay LNR Management Committee** and **Loch Ryan Forum** provide opportunities for users of these areas to discuss activities that may affect seagrass beds.
- Seagrass beds are specifically protected from potentially damaging shellfish harvesting under the management plan drawn up by the **Solway Shellfish Management Association.**

6.2 Other recommended actions

- **Survey** *Zostera marina* beds to determine the current distribution and extent of Dumfries & Galloway populations.
- **Raise awareness** of the importance of the marine environment of Dumfries & Galloway.

HONEYCOMB WORM REEFS

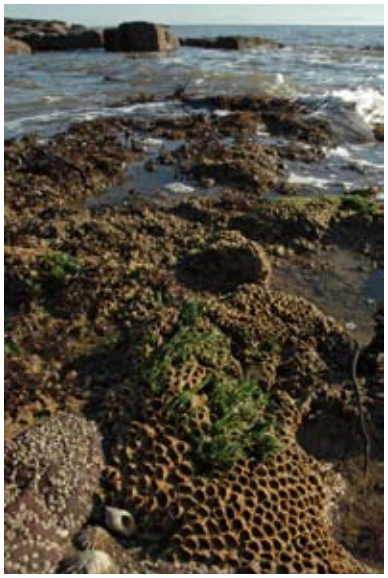
Priority Action (HWR1)

Encourage identification and recording of Honeycomb Worm reefs through the production of public information.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

1. Habitat Description

1.1 Physical Characteristics

Honeycomb worm reefs are composed of tubes of sand built by the marine polychaete Honeycomb Worm *Sabellaria alveolata*. They can cover extensive areas over the shore around the low water mark, particularly where there is a rocky substrate, water with a good supply of suspended sand grains, and strong to moderate wave action. They can also form on other substrates, including pebbles and cockle shells.



Honeycomb Worm reef. Barlocco-Orroland coast, February 2008. (Richard Mearns)

The worms, which are filter feeders, construct tubes in tightly packed masses with a distinctive honeycomb appearance. The reefs can be 30-50cm thick and take the form of hummocks, sheets, overlays or more massive reef formations. Larvae are strongly stimulated to settle by the presence of existing colonies or their dead remains. Individual worms have a life span of 3-5 years, possibly up to 9 years, but reefs last longer as a result of further settlement of larvae onto existing colonies. In the long term, the location of reefs tends to be relatively stable.

New reefs have few associated species, but by their second year a range of seaweeds and animals will have colonised, with some animals eventually living within the older vacated tubes.

1.2 National and International Context

Britain is the northern extremity of the range in the northeast Atlantic, which extends south to the Mediterranean and Morocco. In Britain honeycomb worm reefs are restricted to the west coast between south Devon and the Clyde. Honeycomb worm reefs in the Solway are near their northern limit, but there are some of the best developed and most extensive reefs in Britain here.

2. Dumfries & Galloway Status

2.1 Recent Trends

Recent trends are imprecisely known, but there is no evidence to suggest a decline.

2.2 Current Distribution

Greatest concentrations of honeycomb worm reefs are in the outer Solway, but they occur in several locations from Annan in the east to the Rhins coast in the west.

2.3 Site Examples

The most extensive reefs are found in the **Southerness** (SAC/SPA/SSSI), **Rascarrel/Balcary Bay** (SSSI), **Meikle Ross** (SSSI), **Kirkandrews Bay/Islands of Fleet** (SSSI), and **Stairhaven/ Auchenmalg** (SAC) areas.

2.4 Associated Habitats

A number of habitats occur in close association and/ or overlap with honeycomb worm reefs, and the following action plans may also contain relevant information: Subtidal Rock, Intertidal Rocky Shores.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

A number of marine invertebrates are found on and within crevices of the reefs, including small crabs, barnacles, dogwhelks, winkles, mussels and other bivalves such a nut shell *Nucula nucleus* and a gaper shell *Sphenia binghami*. Small worms such as *Fabricia stellaris* and *Golfingia* spp, and their predators, may also occur within the colonies.

3.2 Non-flowering Plants (high importance)

Over time, seaweeds including Dulse *Palmaria palmata*, *Polysiphonia* spp, *Ceramium* spp, gutweeds *Enteromorpha* spp and Sea Lettuce *Ulva lactuca* colonise the reefs.

Rock Goby (eating prawn), one of several fish that may be found in the reef crevices. (Paul Naylor)

3.3 Fishes (low importance)

Blennies *Blenniidae* and other common seashore fish are found within the crevices.

3.4 Birds (low importance)

Several species of wading bird occasionally feed on the reefs at low tide, including Oystercatchers *Haematopus ostralegus* and Turnstones *Arenaria interpres*.

4. Environmental, Economic & Social Importance of Biodiversity

The formation of honeycomb worm reefs may lead to the creation of more rockpools on the lower shore, which can be of educational and recreational value as well as biodiversity value.

Close-up of individual Honeycomb Worm tubes. Ravenshall, July 2007. (Peter Norman)

5. Factors affecting the Habitat

- Dieback occurs following extremely **cold winters**, particularly at higher shore levels.
- Although they can tolerate burial by sand for days or even weeks, prolonged **burial** causes mortality.
- **Coastal engineering** works, where it affects supply of sand can cause both positive and negative impacts depending upon the nature of the work.
- **Competition** with Common Mussels.
- **Wave exposure** may affect recruitment
- **Recreational activities** such as trampling by beach users and bait digging by anglers have the potential to cause damage, though on a localised and limited scale.

Turnstones feed on intertidal rocky shores, including Honeycomb Worm reefs. (Gordon McCall).

6. Strategic Actions

6.1 Recent and current activity

- Honeycomb worm reefs are identified in the Solway Firth and Luce Bay & Sands SACs.

6.2 Other recommended actions

- **Locate and map** all honeycomb worm reefs in Dumfries & Galloway.
- **Raise awareness** of honeycomb worm reefs through interpretation.

INTERTIDAL ROCKY SHORES

Priority Action (IRS1)

Examine the current extent and future potential for the sustainable collection and co-ordinated local marketing of shellfish from intertidal rocky shores.
Target: Complete a study on shellfish gathering by 2015.
Lead Partner: Solway Firth Partnership

1. Habitat Description

1.1 Physical Characteristics

Intertidal rocky shores consist of bedrock outcrops or boulders, and can be located anywhere from exposed open coasts to sheltered bays. Although the geology and topography determines the type of shore, wave action is the biggest influence on biodiversity. Sheltered rocky shores are dominated by large brown seaweeds, whilst on exposed shores barnacles, limpets and small red seaweeds predominate. Most rocky shores have a wide variety of microhabitats and therefore have a high diversity of species, if a lower overall biomass than intertidal sand and mud flats.

Ranger-led school visit at Wigtown Bay. (Dumfries & Galloway Council)

Kelp forests occur on the seaward edge of some rocky shores. The kelp stipes are often seen sticking out of the sea at low water, but only on the lowest tides are some of the uppermost plants completely exposed. The remainder of these seaweed forests extends offshore up to depths of 20m or more.

The main intertidal zone can be divided into the **lower shore,** the **mid shore,** and the **upper shore.** Although the precise boundaries between each are not always easy to distinguish, the differing wave exposure and length of time covered by seawater often results in a zonation of flora and fauna rarely seen in other habitats.

The biodiversity of rockpools is dependent on their size, depth, shape and position on the shore, with deep pools on the lower shore providing the richest habitat. Shallower pools on the upper shore are subject to extreme daily, tidal and seasonal fluctuations in temperature, salinity and pH so that they are only inhabited by the most environmentally tolerant organisms.

The **splash zone** is found just above the level of ordinary high tides and consists of rock faces and boulders influenced by wave splash and sea spray. However, the small difference in elevation results in quite different environmental conditions and biodiversity, with much more similarity to terrestrial rather than marine habitats.

1.2 National and International Context

Intertidal rocky shores are common around the coast of the UK. The Solway Firth has a large proportion of the rocky seashore found within the whole of the Irish Sea basin.

2. Dumfries & Galloway Status

2.1 Recent Trends

Intertidal rocky shores are robust and few, if any, recent human activities have had a significant impact on this habitat.

2.2 Current Distribution

Extensive kelp forests are rare in Dumfries & Galloway, but other intertidal rocky shore habitats are diverse and extensive, particularly to the west of Southerness. Most rocky shores are on the south facing and sheltered Solway coast, but the western coast is far more exposed, resulting in a diverse assemblage of species throughout the region.

2.3 Site Examples

There are extensive rocky shores at numerous sites. Kelp forests are found at **Lady Bay** in Loch Ryan and at **Mull of Galloway**. The rocky pond at **Port Logan**,

used to keep fish, provides an unusual feature, now promoted as a visitor attraction and marine life centre.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with intertidal rocky shores, and the following action plans may also contain relevant information: Subtidal & Intertidal Scar Grounds, Intertidal Sand and Mud Flats, Honeycomb Worm Reefs, Coastal Strandlines, Coastal Shingle Beaches, Coastal Sandy Beaches, Coastal Cliffs and Slopes.

Rockpools are fascinating subjects for outdoor education and enjoyment. Orroland, April 2007. (Richard Mearns)

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Seaweeds are the main producers of energy in this habitat, and show clear zonation on most intertidal rocky shores.

Kelp forests consist of a range of brown seaweeds, including Oarweed *Laminaria digitata*, Sugar Kelp *Saccharina latissima* and Dabberlocks *Alaria esculenta*. Many smaller red seaweeds find refuge amongst the kelp.

On the **lower shore** brown seaweeds are frequently dominated by Serrated Wrack *Fucus spiralis*. *Petrospongium berkeleyi* has been recorded at Mull of Galloway, one of only a handful of Scottish records, but is otherwise restricted to southwest England and Wales. Another scarce brown seaweed *Corynophlaea crispa* at Mull of Galloway is epiphytic on a common red one, *Chondrus crispus.* Red seaweeds are found throughout the intertidal zone, but are perhaps most diverse on the lower shore. Two tiny bright red-purple species *Erythrotrichia investiens* and *E. bertholdii* grow on other algae in the lower intertidal and shallow subtidal zone. They are recorded from very few other sites in the UK, although identification and taxonomy problems mean that they are likely to be under-recorded.

The **mid shore** is often dominated by Bladder Wrack *Fucus vesiculosus*, though Egg Wrack *Ascophyllum nodosum* may be abundant in sheltered conditions. On more exposed shores other species dominate; a brown seaweed *Alaria esculenta* is common in exposed conditions, whilst the red *Aglaothamnion sepositum* is confined to extreme wave battered shores. The green seaweed *Tellamia contorta* is known from the Rhins, but is difficult to find and probably widespread, being largely restricted to the inside of living periwinkle shells.

The **upper shore** is characterised by Channel Wrack *Pelvetia canaliculata* and sometimes Spiral Wrack *Fucus spiralis*, though Sea Lettuce *Ulva lactuca* and Gutweed *Enteromorpha intestinalis* can be common in brackish conditions.

Rockpools support many of the same species of algae found elsewhere on rocky shores, but seaweeds rarely dominate. The pool rims are typically encrusted with red coralline algae, especially *Lithothamnion* species and *Corallina officinalis*, which are difficult to find elsewhere on the mid and upper shores.

Sea Ivory lichen Ramalina siliquosa, common on upper shores. Powillimount, March 2008. (Peter Norman)

A few mosses can also withstand sea spray and are found in the splash zone. Most typical is Seaside Grimmia *Schistidium maritimum* on boulders just above the high tide mark.

3.2 Invertebrates (high importance)

Invertebrates on rocky shores are predominantly marine species, with smaller numbers of terrestrial species on the upper shore.

Wave exposure is the biggest influence on biodiversity. Black Head, Killantringan, March 2007. (Peter Norman)

The gaps between holdfasts in **kelp forests** support a diverse range of invertebrates including the Blue-rayed Limpet *Helcion pellucidum*, sea urchins, sea squirts and sponges.

The **lower shore** also includes marine species such as Edible Crab *Cancer pagarus*, whilst some species of the **mid and upper shores** are virtually restricted to intertidal rocky habitats, including Rough Periwinkle *Littorina saxatilis*, Common Limpet *Patella vulgata*, and Dog Whelk *Nucella lapillus*. Of terrestrial species, two nationally scarce ground beetles are associated with the upper shore. *Aepus marinus*, recorded in the Machars, is found under stones on fine sand or shingle and in rock crevices; *Aepus robini* (Kirkcudbrightshire and Wigtownshire) shows a greater tendency to inhabit deep sand or silt-filled rock crevices.

Although the invertebrate fauna of **rockpools** generally reflects local rocky shore communities, a few species appear particularly well adapted to pool living including some tiny sea slugs, cushion stars and brittlestars. Beadlet Anemones *Actinia equina*, Shore Crabs *Carcinus maenas*, and several species of prawn are more typical rockpool inhabitants.

The hoverfly *Eristalinus aenus* is found in rotting seaweed in rockpools, as well as brackish pools on saltmarshes, and has been recorded in several locations along the coast of Dumfries & Galloway.

3.3 Fishes (medium importance)

Intertidal rocky shores are the main habitat for a number of fish species, although most are present in the **mid and upper shores** only during the spring and summer, moving downshore, or even offshore, in the winter. The Common Blenny *Lipophrys pholis*, Rock Goby *Gobius paganellus* and Butterfish *Pholis gunnellus* are typical species.

3.4 Birds (medium importance)

Purple Sandpipers *Calidris maritima* feed in the **splash zone** of rocky shores. In Dumfries & Galloway they are only regularly recorded in small numbers around the lighthouse at Southerness. Other birds that feed on rocky shores include Turnstones *Arenaria interpres*, Oystercatchers *Haematopus ostralegus*, and Rock Pipits *Anthus petrosus*. The latter two species regularly nest just above the intertidal zone.

3.5 Fungi and Lichens (medium importance)

A range of colourful lichens dominate the **splash zone**, including the black *Verrucaria maura*, the orange *Caloplaca marina*, the yellow *Xanthoria parietina,* the grey *Lecanora atra* and the green Sea Ivory *Ramalina siliquosa.*

3.6 Mammals (medium importance)

Otters *Lutra lutra* feed on intertidal rocky shores and undisturbed rocky shores are used by Grey Seals *Halichoerus grypus* and rarely Common Seals *Phoca vitulina* as haul-out sites, but few other mammals make extensive use of this habitat.

3.7 Flowering Plants (low importance)

Typical flowering plants of the upper shore include Common Scurvy Grass *Cochleria officinalis*, Thrift *Armeria maritima* and Buck's-horn Plantain *Plantago coronopus.*

3.8 Reptiles and Amphibians (low importance)

Adders *Vipera berus* and Common Lizards *Zootoca vivipara* occasionally visit intertidal rocky shores, but the habitat does not support important reptile and amphibian populations.

4. Environmental, Economic & Social Importance of Biodiversity

- Intertidal rocky shores provide the classic outdoor classroom for teaching ecology from pre-school up to post graduate levels.
- Rockpooling is a popular recreational activity for visitors to the coast.

5. Factors affecting the Habitat

- Pollution from **shipping wastes** and cargoes, such as oil and chemicals.
- Pollution from the land, including **sewage discharges, run-off from roads and farmland**, and the **dumping** of garden waste and other commercial waste, including rubble tipped to prevent erosion.
- The extent and impact of **commercial shellfish gathering** is not accurately known.

6. Strategic Actions

6.1 Recent and current activity

- Guided walks and school activities are run by the Ranger Services of Dumfries & **Galloway Council, National Trust for Scotland** and **Hoddom and Kinmount Estates.** These include annual participation in World Oceans Day.
- "The Sea Chest", which contains books, CDs and activities related to the sea shore is available for loan from **Scottish Natural Heritage** to schools and community groups throughout Dumfries & Galloway.

6.2 Other recommended actions

- Promote the use of intertidal rocky shores for **educational visits**.

Serrated Wrack Fucus serratus, a typical seaweed of the mid shore. Port Kale, June 2003. (Maggi Kaye)

COASTAL STRANDLINES

Priority Action (CS1)

Raise awareness of the importance of coastal strandlines and the potential impacts that may result from physical damage/removal of them by including information in publications or interpretation panels.
Lead Partner: Solway Firth Partnership/Scottish Natural Heritage.

Strandline at Carrick, Fleet Bay. May 2008. (Richard Mearns)

1. Habitat Description

1.1 Physical Characteristics

Coastal strandlines occur on all low-lying coasts where space allows the accumulation of tidal debris. This includes sandy beaches, intertidal rocky shores, shingle beaches and saltmarshes. Extreme high tides mean that this zone may extend several metres landward of the normal high water mark. **Seaweed** usually forms the bulk of strandline material, but **driftwood** is also usually present.

Vegetated strandlines occur on sandy or shingle beaches and consist of various specialist plants - mostly annual species. Their seeds are washed in by the tide and protected by strandline debris from excessive evaporation and extremes of temperature (midday temperatures may be 20ºC higher in open sand) until they germinate. The development and botanical composition of strandline communities often varies considerably from one year to another.

1.2 National and International Context

Stretches of coast where seaweed, driftwood and other organic debris accumulates in sufficient quantity to support a full strandline flora and fauna are not common in the UK.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been an increasing tendency to regularly remove strandlines on beaches using mechanical methods. This has arisen as a result of increasing amounts of unsightly litter being washed up within strandlines, as well as a lack of understanding of the ecological and environmental importance of natural strandline material. Mechanical beach 'cleaning' is now carried out on several beaches in the west of the region.

2.2 Current Distribution

Strandlines occur on much of the Dumfries & Galloway coastline, being absent only where coastal cliffs and slopes directly abut the sea. They are perhaps commonest on the more exposed coasts of the west.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal strandlines, and the following action plans may also contain relevant information: Intertidal Rocky Shores, Coastal Shingle Beaches, Coastal Sandy Beaches, Coastal Saltmarshes (Merse).

3. Importance for Associated Species

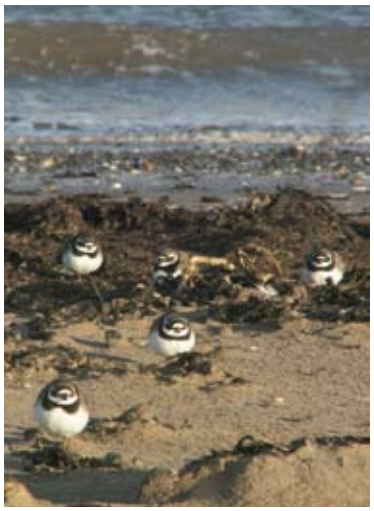
3.1 Invertebrates (very high importance)

A large number of common invertebrates frequent coastal strandlines including spiders such as *Pardosa purbeckensis;* ground beetles such as *Broscus cephalotes, Dicheirotrichus gustavi* and *Pogonus chalceus;* and several species of rove beetle and kelp fly. Of greatest abundance are sandhoppers *Talitris saltator.* The richest communities occur in thick, wet and rotting **seaweed** rather than amongst small amounts of dry weed. These invertebrates are the main prey items for birds feeding on strandlines.

Scarce and rare invertebrates also occur. The Mouse-eared Snail *Ovatella myosotis* is found in muddy sheltered places at high tide level in brackish estuaries and saltmarshes in Dumfriesshire, often under **driftwood** and other flotsam. Indeed, a number of invertebrates, especially beetles, feed preferentially or exclusively on sea-soaked wood on the strandline. The nationally scarce spider *Argenna patula* occurs in strandline litter on the estuary at Wigtown Bay, whilst the woodlouse *Armadillidium album* and the Sand Dart moth *Agrotis ripae* have been recorded on Luce Sands, one of their few Scottish locations. Amongst the species found below the strandline debris at Auchencairn Bay is the nationally scarce ground bug *Scoplostethus pictus*, which in the UK has a predominately southern distribution.

3.2 Birds (high importance)

Waders such as Oystercatchers *Haematopus ostralegus*, Turnstones *Arenaria interpres* and Curlews *Numenius arquata* feed on the strandline, along with passerine birds such as Rock Pipits *Anthus petrosus*, Linnets *Carduelis cannabina*, Twites *Carduelis flavirostris* and Choughs *Pyrrhocorax pyrrhocorax*. Other species roost on the strandline at high tide.



Ringed Plovers on seaweed strandline at Loch Ryan, January 2008. (Gavin Chambers)

Frosted Orache on the strandline at Brighouse Bay. June 2004. (Peter Norman)

3.3 Flowering Plants (medium importance)

Typical species of the strandline include Frosted Orache *Atriplex laciniata*, Sea Sandwort *Honckenya peploides*, Sea Rocket *Cakile maritima* and Prickly Saltwort *Salsola kali*, the latter experiencing drastic decline in some parts of Britain. The nationally scarce Early Orache *Atriplex praecox* occurs on vegetated strandlines of sand and shingle beaches, and Isle of Man Cabbage *Coincya monensis* subsp. *monensis* is virtually restricted to coasts between Liverpool and Glasgow, as well as the Isle of Man.

3.4 Reptiles and Amphibians (medium importance)

Slow Worms *Anguis fragilis* and Common Lizards *Zootoca vivipara* may occasionally forage on the strandline. In the areas where Natterjack Toads *Epidalea calamita* occur, these animals have been found using **driftwood** and other strandline materials as daytime refuges. Such refugia are very important for the toads.

3.5 Fungi and Lichens (low importance)

Few species of fungi occur in strandlines, although a small number of species occur on **driftwood**. Microfungi may be important in the breakdown of shells and other inorganic substances produced by animals.

4. Environmental, Economic & Social Importance of Biodiversity

- Through the decomposing action of invertebrates and bacteria, strandlines supply most of the organic material in the upper sections of sandy beaches. Without this organic material and the life it supports these beaches are more prone to be washed away during storms.
- Strandlines are very often the first stage in the formation of coastal sand dunes. Removal of strandlines may therefore weaken the natural protection against erosion and flooding afforded by dunes.
- In some locations, such as Balyett in Loch Ryan, birdwatchers are attracted to view birds that feed on the strandline.

Driftwood with nest holes of leaf-cutter bees. Claymoddie, Luce Bay, August 2007. (Peter Norman)

5. Factors affecting the Habitat

- **Mechanical beach cleaning** totally destroys this habitat. Even seasonal or occasional removal of the strandline will disrupt invertebrate breeding cycles.
- Use of driftwood for **barbecues and bonfires** can locally reduce invertebrate communities.
- **Recreational use** at high tide locally disturbs roosting birds.

6. Strategic Actions

6.1 Recent and current activity

- The **Marine Conservation Society** Beachwatch and Adopt-A-Beach campaigns encourage communities to monitor and clean beaches in an environmentally responsible way.

6.2 Other recommended actions

- **Avoid wholesale mechanical cleaning** of beaches, especially tidelines.
- Remove plastic litter from strandlines by **hand picking** to avoid ecological damage.
- Encourage **educational activities**, including community beach cleans.

COASTAL SHINGLE BEACHES

Priority Action (CSB1)

Assess the importance for invertebrates of coastal shingle in Dumfries & Galloway.
Target: Complete an invertebrate survey of selected beaches by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Port of Counan, Luce Bay, with Sea Kale. August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

The term shingle is applied to any sediment ranging in grain size between 2 mm (large sand grain size) and 200 mm (large stones). Shingle beaches form in high-energy environments where the sea can move and pile up shingle on the shore above the tideline. These beaches can have a relatively simple structure, or the shingle can form a more complex spit and multiple ridge system.

Unvegetated shingle is able to persist on beaches that are exposed to extreme environmental influences.

Above normal high tidelines, shingle can become a relatively stable area on which specific shingle vegetation can grow, adapted to conditions that are saline, mobile and poor in organic matter. **Vegetated shingle** will also establish on beaches where there is a matrix of finer material such as sand or silt, and hydrological conditions are also an important influence on vegetation. Much of the initial nutrient supply comes from rotting seaweed and other strandline vegetation, including **driftwood** washed in by the sea. Usually herb-rich open **pioneer vegetation** forms on the seaward side of shingle beaches, but **moss and lichen heath, grassland, and scrub** may form on more stable shingle further inland.

1.2 National and International Context

Coastal shingle is globally restricted to north-west Europe, Japan and New Zealand, with few occurrences outside these areas.

It is estimated that 30% of the UK coast is fringed by shingle beaches, which are widely distributed. However, most of this consists of simple, unvegetated beaches. Only 4000ha of semi-stable vegetated shingle occurs, and long stretches of partially vegetated raised shingle beaches of the type found on Luce Bay are scarce in the UK.

2. Dumfries & Galloway Status

2.1 Recent Trends

Some coastal shingle has been mechanically excavated, but the generally poor access to most of the region's important shingle beaches has protected them from excessive extraction and recreational disturbance.

2.2 Current Distribution

Most shingle beaches in Dumfries & Galloway are bounded on the landward side by raised beaches (with roads at some locations), cliffs and other maritime slopes, rocky protrusions and remnant sand dunes. On the sea-ward side they are fringed by various marine habitats including mud and sand, cobbles and boulders.

There are many unvegetated shingle or sparsely vegetated beaches, with those in Loch Ryan being of particular importance for nesting birds. The most important areas for vegetated coastal shingle are the bays of Kirkcudbrightshire from Balcary Point to Gypsy Point, and the eastern shore of Luce Bay from Carghidown cliffs to the Mull of Sinniness. Vegetated shingle is present along 35 km of the Solway Firth coastline, with 41 sites where shingle is greater than 100 m in length.

2.3 Site Examples

The eastern shore of **Luce Bay** (SAC) contains some of the most extensive and important vegetated shingle beaches in Britain. Smaller vegetated shingle beaches are found on the Kirkcudbrightshire coast, including **Rascarrel Bay** (SSSI) and **Abbey Burnfoot** (SSSI). **The Scar** in Loch Ryan, near Kirkcolm, is the most important shingle beach in the region for birds.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal shingle beaches, and the following action plans may also contain relevant information: Intertidal Rocky Shores, Coastal Strandlines, Coastal Sandy Beaches, Coastal Cliffs and Slopes.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Shingle sites on the Solway Firth are significant locations for 16 plant species at or near their northern or southern limits of distribution. For example, Yellow

Yellow Horned-poppy, one of several flowering plants restricted to coastal shingle. Port of Counan, July 1999. (Peter Norman)

Horned-poppy *Glaucium flavum* is at its northern limit and the nationally scarce Oysterplant *Mertensia maritima* close to its southern limit.

Pioneer vegetation, including species such as Sea Spurge *Euphorbia paralias* and Sea Kale *Crambe maritima,* can tolerate periodic movement. Other notable species include Portland Spurge *Euphorbia portlandica*, Early Orache *Atriplex praecox*, Isle of Man Cabbage *Coincya monensis* subsp. *monensis*, Ray's Knotgrass *Polygonum raii*, and Wood Vetch *Vicia sylvatica*.

The raised shingle beaches of the Solway are important for shingle **scrub,** comprising of Gorse *Ulex europaeus* and Bramble *Rubus fruiticosus* that thrives in acid conditions. Blackthorn *Prunus spinosa*, Hawthorn *Crataegus monogyna*, and Burnet Rose *Rosa pimpinellifolia* also occur, often in prostrate form on the lower shore. Rascarrel Bay has a locally unique shingle habitat that supports wet scrub composed of sallow *Salix cinerea* and Hazel *Corylus avellana*.

3.2 Invertebrates (high importance)

Many species of invertebrate are dependent upon shingle vegetation. The most interesting sites are those where the shingle extends above the normal high tide limit and is at least partially vegetated.

The larvae of the micro-moth *Scrobipalpa clintoni* feeds within the leaves of the common plant Curled Dock, but the moth was only discovered in 1965 and so far in Britain has only been recorded on sand and shingle beaches on the west coast of Scotland, including at Borgue and Cairnryan.

Driftwood on shingle beaches is usually exposed to full sunlight and drying winds. It therefore supports fewer invertebrate species than dead wood in other locations, but can be extremely important for a few species, especially for bees and wasps that feed on adjacent flower-rich grassland.

3.3 Birds (high importance)

Birds such as Oystercatchers *Haematopus ostralegus* and Ringed Plovers *Charadrius hiaticula* nest on shingle beaches and feed at the adjacent strandline and shore. The Scar at Wig Bay in Loch Ryan supports Dumfries & Galloway's largest tern colony with Common Terns *Sterna hirundo*, Arctic Terns *Sterna paradisaea,* Sandwich Terns *Sterna sandvicensis* and sometimes rare Little Terns *Sterna albifrons* nesting on the shingle. Other species roost on the strandline at high tide.

Sandwich Terns nest on undisturbed shingle beaches. Loch Ryan, April 2008. (Gavin Chambers)

3.4 Fungi and Lichens (medium importance)

There are interesting lichen communities on undisturbed upper shingle areas where no organic material has collected, and amongst pioneer vegetation. Species of *Cladonia* are most obvious, including *C. portentosa* and *C. furcata* subsp. *furcata.*

Cladonia portentosa lichen. Claymoddie shore, Luce Bay, August 2007. (Peter Norman)

3.5 Reptiles and Amphibians (medium importance)

All three Scottish reptile species are found on coastal **vegetated shingle**.

3.6 Non-flowering Plants (low importance)

Mosses and liverworts may be totally absent from mobile shingle, but some species occur on more stable **vegetated shingle** beaches including Broom Fork-moss *Dicranum scoparium* and Neat Feather-moss *Scleropodium purum*.

4. Environmental, Economic & Social Importance of Biodiversity

Shingle beaches are found on exposed coasts with high-energy waves. They therefore provide important protection against coastal erosion, including protection for several roads and houses.

5. Factors affecting the Habitat

- Disruption of the dynamics of shingle beach processes by coastal defence or other **construction works** that interrupts the steady supply of new shingle material.

- **Dredging** of offshore shingle/gravel ridges, stopping the natural addition of this material to the shingle beaches.
- Damage by gravel and sand **extraction** for private and commercial purposes.
- Several sites, including those containing significant plant species, have no formal conservation status and are at risk from **dumping** of building rubble, garden waste and household rubbish, unauthorised **parking** or disturbance from inappropriate **recreational use.**
- **Non-native species**, especially Japanese Knotweed, have invaded some areas of shingle.
- **Wash from high speed ferries** may cause erosion and disturbance to bird colonies in Loch Ryan.
- There is a **lack of understanding** of the value of shingle areas.
- **Climate change** may threaten a number of Dumfries & Galloway's coastal shingle beaches.

Carline Thistle, with bumblebee Bombus terrestris. Port of Counan, August 2007. (Peter Norman)

6. Strategic Actions

6.1 Recent and current activity

- SNH commissioned an **Inventory of Shingle Vegetation Survey** in the Solway in 2000.
- The first phase of the Dumfries & Galloway **Shoreline Management Plan** was published in 2005. This identifies important shingle beaches and the protection they provide against erosion.
- Some areas have been given protection through statutory **designations.**

6.2 Other recommended actions

- **Manage pedestrian and vehicle access** to coastal shingle areas to minimise disturbance.
- **Discourage tipping** of garden and household waste on shingle areas.
- Undertake a **baseline survey** of breeding birds on shingle areas.
- **Raise awareness** of the importance of coastal shingle through educational events and publications.

COASTAL SANDY BEACHES

Priority Action (CSB1)

Encourage people to visit and enjoy coastal sandy beaches and their associated habitats and learn about their biodiversity and sustainable management.
Target: Produce a guide to Dumfries & Galloway's beaches, including their biodiversity, by 2012.
Lead Partner: Solway Firth Partnership.

White Port Bay at the mouth of Rough Firth. June 2005. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Sand is a homogeneous habitat in comparison to rock, and sandy beaches may appear flat, featureless and empty of life. However, the majority of life remains permanently buried under the surface. The nature of the beach is largely determined by wave action, and this has an important influence on biodiversity.

Sheltered beaches are steep with **coarse sands** that drain well and dry rapidly. The sand tends to be clean and hold little organic content. In the most extreme examples, biodiversity is limited.

Wave exposed beaches are flat with low profiles and **fine sands** that take longer to be flushed by seawater, but have lower oxygen levels. They accumulate organic material that fuels teeming bacterial populations, which supports an enormous biomass of other life.

Most beaches are intermediate between coarse and fine sands, or have different conditions in different parts of the beach. Some beaches may even change from one sediment type to another and back again.

1.2 National and International Context

Sandy beaches are widespread around the coast of the UK.

2. Dumfries & Galloway Status

2.1 Recent Trends

Dumfries & Galloway's coastal sandy beaches remain largely unspoilt by major developments.

2.2 Current Distribution

Most of Dumfries & Galloway's sandy beaches are located to the west of Southerness.

2.3 Site Examples

The most extensive sandy beaches are found around **Sandhead** at the head of Luce Bay, and between **Southerness** and **Mersehead**. There are also notable beaches at **Sandyhills, Sandgreen, Port Logan** and **Broadsea Bay**, along with a number of other smaller beaches.

Sea Sandwort, a pioneer coloniser of sandy beaches. Brighouse Bay, June 2004. (Peter Norman)

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal sandy beaches, and the following action plans may also contain relevant information: Intertidal Sand and Mud Flats, Coastal Strandlines, Coastal Shingle Beaches, Coastal Sand Dunes.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

Though some invertebrate groups are rare or absent from sandy beaches, bristleworms *Polychaete*, bivalve molluscs and amphipod crustaceans are abundant and total biomass may be enormous. Most species are tiny, but these vastly outnumber the larger invertebrates. The upper shore of free-draining beaches of **coarse sand** is a hostile environment for marine life and only a few burrowing invertebrates such as amphipods *Bathyporeia* spp, an isopod *Eurydice pulchra* and a tube worm *Scolelepis squamata* are likely to occur to any extent.

A small number of terrestrial invertebrates also occur, such as a ground beetle *Dyschirius thoracicus* recorded on bare sandy shores in Kirkcudbrightshire. A few species are associated with vegetation, but this is of minor importance in comparison to the fauna associated with dead material on the strandline.

3.2 Flowering Plants (medium importance)

On more stable sands, usually at the top of the beach, a number of pioneer plants are able to secure a foothold. These include Frosted Orache *Atriplex laciniata,* Sea Sandwort *Honckenya peploides,* Sea Rocket *Cakile maritima* and Prickly Saltwort *Salsola kali.* The latter species has undergone a dramatic decline in some areas, possibly as a result of recreational pressure.

Sea Rocket. Ardwell Bay, September 2007. (Peter Norman)

Sanderlings are mainly seen on Solway beaches in the spring and autumn. (Gordon McCall)

3.3 Birds (low importance)

Sandy beaches are of low importance for birds compared to intertidal sand and mud flats. The main specialists are Sanderlings *Calidris alba,* though most of these birds pass through Dumfries & Galloway only during a few weeks each spring and autumn. Other waders, gulls and terns occasionally feed and roost on sandy beaches.

3.4 Fishes (low importance)

Dragonets *Callionymus lyra* are found partly buried in very shallow waters on sandy beaches. Lesser Weavers *Trachinus draco* are active at night but spend the day buried in sand, except for their backs and dorsal fins, which can give a painful sting if trodden on.

3.5 Fungi and Lichens (low importance)

Some tiny fungi are adapted to live on detritus in the upper layers of sandy beaches, producing miniature fruitbodies attached to grains of sand.

4. Environmental, Economic & Social Importance of Biodiversity

Sandy beaches have a very high recreational, tourism and landscape value.

Seemingly barren beach - the biodiversity is all buried in the sand. Ardwell Bay, July 2006. (Peter Norman)

5. Factors affecting the Habitat

- The **driving of vehicles** on sandy beaches can damage fragile communities.
- **Litter** is more of an eyesore than a threat to biodiversity, but in some cases can affect wildlife.
- **Mechanical beach cleaning** can damage biodiversity and disrupt natural beach processes.

6. Strategic Actions

6.1 Recent and current activity

- A number of beaches are designated **Bathing Waters** where water quality is monitored to ensure that it meets required standards. Beaches have shown a gradual improvement since monitoring began.
- A few beaches have been adopted by community groups under the **Marine Conservation Society**'s Adopt-a-beach campaign.

6.2 Other recommended actions

- **Avoid wholesale mechanical cleaning** of beaches, especially tidelines.
- Encourage **educational activities**, including community beach cleans.
- **Promote the natural importance** and sustainable management of Dumfries & Galloway's beaches.

COASTAL SAND DUNES

Priority Action (CSD1)

Improve habitat quality of coastal sand dunes.
Lead Partner: Defence Estates/Scottish Natural Heritage.

Lyme Grass and Marram Grass on embryo dunes at Back Bay, Monreith. May 2006. (Peter Norman)

1. Habitat Description

1.1 Physical characteristics

Sand dunes develop on coasts where there is an adequate supply of sediment within the size range 0.2 to 2mm. The critical factor is the presence of a beach that dries out at low tide and where the sand grains are blown onto the land by the wind. Vegetation prevents dispersal of the sand. Some dunes occur in narrow coastal strips where geological factors limit sand availability, but others extend well inland.

Embryo dunes form a transitional zone at the top of sandy beaches. They are colonised by pioneer plants able to cope with wind, salt and drought conditions. Further inland **foredunes,** sometimes called yellow dunes, are actively building dunes. Constant sand burial and sea spray restricts the range of plants. **Fixed dunes**, or grey dunes, are more sheltered and stable environments, but still have a very shallow and fragile soil with a very low water content.

The high calcium content of **dune grasslands** results from the breakdown of shells, and results in a species-rich habitat. However, in locations without shell sand a more acidic plant community can develop, often **dune heath** dominated by Heather.

Dune slacks are areas of wetland within the dune system. They can include seasonal pools, swamps and fens. **Dune scrub** develops in both dry and wet areas of the dune system, with willows dominating in the latter.

1.2 National and International Context

Coastal sand dunes have a wide distribution throughout Europe. Around 50,000ha of dune habitat is widely distributed around the British coastline with around 31,000ha in Scotland. In Britain 43 sites exceed 50ha and are considered to be of national importance.

An estimated 689ha is currently found in Dumfries & Galloway, comprising of 2ha of embryo dune, 32ha of foredune, 253ha of acidic fixed dune grassland, 37ha of neutral-calcareous fixed dune grassland, 192ha of dune heath and bracken, 2ha of dune slack, 133ha of other dune wetland and 38ha of dune woodland and scrub.

2. Dumfries & Galloway Status

2.1 Recent Trends

The biodiversity value of sand dunes has increasingly become recognised and little deliberate loss or damage has occurred in Dumfries & Galloway in the last decade. Some dunes have, however, experienced coastal erosion.

2.2 Current Distribution

Sand dunes are restricted to the coastline from the Nith estuary westwards.

2.3 Site Examples

Torrs Warren (SAC/SPA/Ramsar/SSSI) encompasses the largest and most complex beach and dune system in southern Scotland. It is predominantly acidic dune heath with slacks and some dune grassland, and is outstanding for its geological, botanical, entomological and ornithological interest.

A narrow belt of Marram-dominated dunes occurs from **Southerness to Mersehead** (SSSI) and at **Port Logan** (LWS). At the head of **Brighouse Bay** (SSSI) there is a small area of embryo dunes and dune grassland. Narrow belts of dune habitat occur elsewhere on the Galloway coast, for example at **Sandyhills Bay**, **Almorness**, **Fleet Bay**, **Monreith**, and **Killantringan Bay.**

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal sand dunes, and the following action plans may also contain relevant information: Coastal Sandy Beaches, Scrub Woods.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Foredunes contain a small but specialised invertebrate fauna. Two species of moth are virtually restricted to this habitat. The Coast Dart *Euxoa cursoria*, which feeds on dune plants such as Sea Sandwort, Sand Couch and Early Hair Grass, has been recorded rarely in Dumfries & Galloway; the nationally scarce Belted Beauty *Lycia zonaria* has yet to be confirmed in Dumfries & Galloway but may occur on foredunes.

Coastal sand dunes are better suited to support warmth-loving invertebrates than any other habitat. A common ground beetle *Calathus mollis* is almost exclusively found in **fixed dunes,** with records from Kirkcudbrightshire and Wigtownshire. A spider-hunting wasp *Evagetes crassicornis* has been recorded at Torrs Warren, in one of only six 10km squares in Scotland, whilst Dune Robberfly *Philonicus albiceps* and Pied-winged Robberfly *Pamponerus germanicus* are near their northern limits in Galloway. Dunes are especially important for bees and wasps, with bare sand of particular value for hunting and burrowing. A mining bee *Colletes fodiens* is present at its only Scottish site at Torrs Warren, although its relative the Northern Colletes Bee *Colletes floralis* has not been refound recently. Fox and Emperor Moths *Macrothylacia rubi* and *Saturnia pavonia* occur on **dune heaths**, as well as other heathland.

Lichen-covered foredunes at Torrs Warren. June 2007. (Peter Norman)

Narrow-mouthed Whorl Snails *Vertigo angustior* are restricted to moist places with short grasses, mosses or low herbs that are quickly warmed by the sun. In Dumfries & Galloway they are found only on marshy **dune grassland** behind dunes at Almorness. The first Scottish record of a nationally scarce money spider *Mecopisthes peusi* was found at Mersehead in 2001.

3.2 Flowering Plants (very high importance)

Sand dunes, especially **foredunes,** form a very hostile environment and flowering plants require adaptations to aid survival, such as the spreading rhizomes of Sand Couch *Elytrigia juncea*, the succulent leaves of Sea Spurge *Euphorbia paralias*, and the fleshy tap root of Sea Holly *Eryngium maritimum*. Growth of Marram Grass *Ammophila arenaria* is stimulated by being covered in sand, whilst Lyme Grass *Leymus arenarius* with its ability to roll its leaves in dry weather, is one of the principal dune-builders.

Perennial Flax at its only Scottish locality on dune grassland at Brighouse Bay. June 2004. (Peter Norman)

Although **fixed dunes** have a greater range of species, many are still highly specialised. Sand Sedge *Carex arenaria* colonises and stabilises with the help of a fast-growing rhizome. The grass *Bromus hordeaceus* subsp. *thominei* has been recorded in Dumfries & Galloway only at Torrs Warren.

Coralroot Orchid *Corallorhiza trifida* has been recorded in the **dune slacks** at Torrs Warren, its only recent site in the region. Common Wintergreen *Pyrola minor* is also found here.

Perennial Flax *Linum perenne* is abundant at its only Scottish site on the **dune grassland** at Brighouse Bay, and within Dumfries & Galloway Pyramidal Orchid *Anacamptis pyramidalis* is only regularly found here and at Port Logan.

3.3 Reptiles and Amphibians (very high importance)

Natterjack Toads *Epidalea calamita*, commonly breed in dune slacks in Britain, but in Dumfries & Galloway more commonly occur in association with saltmarshes. They are found in dunes only in the Southerness to Mersehead area. Great Crested Newts *Triturus cristatus* are known to breed in the slacks at Torrs Warren.

All three Scottish reptiles, Adders *Vipera berus*, Common Lizards *Zootoca vivipara* and Slow Worms *Anguis fragilis* are regularly recorded from dune systems in Dumfries & Galloway.

3.4 Fungi and Lichens (high importance)

Few fungi are associated with mobile sand, but a number of dune specialists are found on **fixed dunes**, including Dune Brittlestem *Psathyrella ammophila*. Some species may enable pioneer dune grasses to capture essential elements such as phosphorus. A rare birds-nest fungus *Cyathus stercoreus* has been recorded on rabbit dung amongst Marram at Torrs Warren. Fixed dunes and **dune heaths** are also important for lichens, particularly species of *Cladonia* that give the dunes their grey appearance. **Slacks** are the most important dune habitat for fungal diversity, though relatively few species are restricted to this habitat.

Moor Club Clavaria argillacea. Torrs Warren, November 2007. (Peter Norman)

3.5 Non-flowering Plants (high importance)

Mosses and liverworts thrive on bare patches of calcium-rich sand, which naturally occur on **foredunes** where cycles of erosion and re-deposition provide fresh surfaces of bare damp sand. Sand-hill Screw-moss *Syntrichia ruralformis* is one of the first to colonise, forming extensive mats that bind the sand together. Once these areas become colonised by larger flowering plants the bare sand disappears and the habitat becomes less suitable. Yellow Crisp-moss

Dune heath, scrub and slack at Torrs Warren. June 2007. (Peter Norman)

Tortella flavorirens is exclusively coastal in Britain. Although it can be found below cliffs and sometimes in crevices in coastal rocks it is most abundant in calcareous sand dunes, usually on fairly stable sand. Several bryophytes are also found in **dune slacks.**

3.6 Birds (medium importance)

No birds are entirely restricted to dunes, but a number of species breed here as well as in other habitats. These include Skylarks *Alauda arvensis* and Linnets *Carduelis cannabina.* Others such as Common Kestrels *Falco tinnunculus*, Short-eared Owls *Asio flammeus,* and Barn Owls *Tyto alba* hunt over dunes.

3.7 Mammals (low importance)

The mammal fauna consists of common and widespread species, such as Field Voles *Microtus agrestis*, Rabbits *Oryctolagus cuniculus*, and Foxes *Vulpes vulpes*. In the absence of livestock, Rabbit grazing may be important in maintaining some plant and invertebrate communities.

3.8 Fishes (low importance)

Dune slacks that hold permanent water support common fish species such as Three-spined Sticklebacks *Gasterosteus aculeatus*.

4. Environmental, Economic & Social Importance of Biodiversity

- Coastal sand dunes provide natural protection against erosion and flooding. For example, Southerness golf course receives considerable protection from the adjacent dune system.
- A number of dune systems occur behind popular bathing beaches, such as Sandyhills and Brighouse Bay, though they are not frequently used by visitors other than to access the beach.

Mating Dark Green Fritillary butterflies on dune heath. Torrs Warren, June 2007 (Peter Norman)

5. Factors affecting the Habitat

- The continued **supply and movement of sand** within the site is fundamental to maintaining the diverse conditions on the site. Sand is supplied by onshore currents and moves landward over time.
- **Mechanical beach cleaning** removes vegetation behind which sand would normally accumulate.
- **Military use** and construction of military facilities at Torrs Warren has damaged some dune habitat. However, military use is likely to have protected it from greater damage from other land uses.
- **Forestry** is not widespread on dunes in the region. Only a relatively small part of Torrs Warren has been planted with conifers, and even here an interesting flora and fauna remains.
- Few of the region's dunes have any form of managed **grazing**. Light grazing with suitable livestock can maintain a diverse vegetation structure and benefit invertebrates.
- Deliberate **burning** of dune heaths has been used as a management tool in the past, but produces few benefits for the habitat. Burning of rank ungrazed heather may result in serious damage. There is also a risk from accidental fires.
- Dumfries & Galloway's dunes do not suffer badly from non-native invasive species, as in some other parts of the UK. However, **bracken and scrub invasion** has been a problem at Torrs Warren.
- Public access can be beneficial on ungrazed sites, but dunes can be damaged by heavy **recreational use.** Provision of boardwalks and the fencing of sensitive areas can control excessive trampling and erosion, though use of tanalised fences and galvanised wire can damage bryophytes. Use of trail bikes has been noted at Southerness, and is extremely damaging.
- Increasing sea levels and storm frequency resulting from **climate change** can cause foreshore steepening and increased wave attack at the base of dunes, resulting in erosion.

6. Strategic Actions

6.1 Recent and current activity

- The most important sand dunes in the region are protected from significant damage through a range of statutory and non-statutory **designations**. This does not, however, always ensure positive habitat management.
- Sands dunes are included within the **Luce Bay and Sands SAC** management scheme and process.
- The **West Freugh Conservation Group** aims to balance potentially conflicting land uses at Torrs Warren.
- **Erosion control**, through fencing and planting of Marram Grass has been carried out by Southerness Golf Course.
- **Visitor management** at Sandyhills Bay involves boardwalks on well-used access routes. At Brighouse Bay, previous parking on dune grassland has been prevented, though responsible access on foot encouraged through provision of gates and interpretation.
- Low-intensity **grazing management** at Brighouse Bay has been reinstated.

6.2 Other recommended actions

- Consider restoration of sand dunes at Torrs Warren through **removal of conifer plantations.**
- Examine the feasibility of **grazing reintroduction** at selected sites.
- Arrange guided walks and **environmental education** activities and publications.
- Conduct **invertebrate surveys**. These would be highly likely to result in the discovery of new species for the region.

COASTAL SALTMARSHES (MERSE)

Priority Action (CSM1)
Continue with current management.

Southwick Merse, August 2007. (Richard Mearns)

1. Habitat Description

1.1 Physical Characteristics

Saltmarshes are areas of specialised vegetation periodically inundated by the tide, often exposed to high daytime temperatures, and with poorly aerated soil. They develop on the middle and upper tidal levels of intertidal mud and sand areas, where fine sediments offer a substrate in a low energy stable environment conducive to the growth of salt tolerant flowering plants (halophytes). Once established, the plants slow water flow and thus increase sedimentation. Usually saltmarsh establishes in sheltered situations within estuaries and behind coastal shingle bars, but some examples are on the open seashore.

Vegetation varies with climate and the frequency and duration of tidal inundation. **Pioneer saltmarsh** vegetation colonises sand and mud flats and is an important precursor of more stable saltmarsh, where, grazing by domestic livestock is particularly significant in determining structure and species composition. **Lower saltmarsh** may be species poor, but on **mid and upper saltmarsh** there is more variation, with the upper marsh forming transitions with reed communities and freshwater grasslands.

A range of small-scale landforms is associated with saltmarshes. In various places the erosional edge of the saltmarsh forms a **saltmarsh cliff** 2-3m high. Tidal water flows in and out of the areas of saltmarsh through **creeks** and runnels that add to the structural diversity and provide a range of microhabitats. The Solway marshes provide the finest British examples of **marsh terraces** formed by the process of creek migration, storms, tidal cycles and geological uplift. Saltmarsh sediment has a very high salt content that decreases towards the upper shore, but salt may accumulate in patches to produce areas of marsh with few plants called **saltpans**.

1.2 National and International Context

Saltmarshes occur on the North Sea, English Channel and Atlantic shores of Europe. There are approximately 29,000ha of saltmarsh in the UK, with around 6,750ha in Scotland. A significant proportion of Scotland's saltmarsh, approximately 2,000ha, is found on the Solway.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little pressure recently for improvement of marshes for agriculture.

2.2 Current Distribution

Extensive saltmarshes are found in the inner Solway and Wigtown Bay, but smaller areas occur in most of the region's estuaries, and occasionally on more exposed coasts.

2.3 Site Examples

Almost 3,000ha of saltmarsh are found on several sites in the inner Solway Firth (SAC/SPA/SSSI). On the Scottish side of the estuary this includes sites at **Browhouses, Dornock, Annan, Priestside Bank, Caerlaverock** (NNR), **Kirkconnell Merse, Carse Bay, Green Merse** and **Southwick Merse**. Several sites show a complete sequence from pioneer to upper saltmarsh and transitions to freshwater habitats. The greatest extent of saltmarsh in the outer Solway is c450ha at **Wigtown Bay** (SSSI/LNR). Smaller areas include c135ha in **Rough Firth** and **Auchencairn Bay** (SSSI), c75ha in **Kirkcudbright Bay,** c25ha in **Fleet Bay** and c35ha in **Luce Bay**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal saltmarshes, and the following action plans may also contain relevant information: Intertidal Sand and Mud Flats, Reedbeds.

3. Importance for Associated Species

3.1 Birds (very high importance)

A number of other wildfowl and wading birds rely on saltmarsh for either breeding, feeding or roosting during the course of the year.

Breeding waders include Oystercatchers *Haematopus ostralegus,* Curlews *Numenius arquata* and Redshanks *Tringa totanus*, Lapwings *Vanellus vanellus* and Snipe *Gallinago gallinago.* Redshanks are particularly important as they have declined as breeding birds in many other habitats. Historically the Solway merses used to be important for breeding Dunlins *Calidris alpina*, gulls and terns although these species now rarely breed.

The entire world population of Svalbard Barnacle Geese *Branta leucopsis* feed on the saltmarshes and surrounding pastures of the Solway during the winter, along with large numbers of Pink-footed Geese *Anser brachyrhynchus* and Greylag Geese *Anser anser*. Other wildfowl such as Pintails *Anas acuta* and Wigeons *Anas penelope* feed on and around saltmarshes. Golden Plovers *Pluvialis apricaria* and Lapwings gather in mixed flocks of up to 1,000, and Peregrines *Falco peregrinus*, Merlins *Falco columbarius* and other birds of prey frequently hunt over saltmarshes during the winter.

Twites *Carduelis flavirostris are* small finches that breed in small numbers in Dumfries & Galloway. Flocks of up to 230 have been recorded on saltmarshes during the winter, although their origins are unknown.

Drying **creeks** and **pans** are often a good hunting ground for Grey Herons *Ardea cinerea*.

3.2 Flowering Plants (high importance)

The natural zones of vegetation on a saltmarsh result from the degree of inundation by incoming tides. Plants with a higher tolerance to salt and inundation are found on the lower saltmarsh, whereas those with a more limited tolerance will be found in the upper marsh. Saltmarsh vegetation also reflects the age, type of sediment and management of the marshes.

Pioneer saltmarsh is typified by species such as Common Glasswort *Salicornia europaea,* which colonise the mud flats, Annual Seablite *Suaeda maritima* and Common Saltmarsh Grass *Puccinellia maritima*. *Salicornia* beds are uncommon on a European and UK scale. These species also occur on open **creeks** and **saltpans**. Above the pioneer zone there is a transition to grassy **lower and mid saltmarsh** dominated by Sea Milkwort *Glaux maritima,* Sea Arrow-grass *Triglochin maritimum,*

Sea Lavender at Auchencairn Bay. August 2008. (Peter Norman).

Sea Plantain *Plantago maritima* Red Fescue *Festuca rubra* Sea Aster *Aster tripolium* and Thrift *Armeria maritima.* Common Sea Lavender *Limonium vulgare* and Lax-flowered Sea Lavender *Limonium humile*, both at the northern edge of their ranges, are found on ungrazed or lightly grazed marshes.

Sea Milkwort, Ringdoo Point, Luce Bay. June 2007. (Peter Norman).

The **upper saltmarsh** is dominated by extensive grazed communities of Saltmarsh Grass *Puccinellia maritima* and Saltmarsh Rush *Juncus gerardii,* and tussocky patches of Sea Rush *Juncus maritimus.* It also includes Sea Wormwood *Seriphidium maritimum*, the uncommon Seaside Centaury *Centaurium littorale* and Lesser Centaury *Centaurium pulchellum* at northern edge of its range, as well as many plants that are not specialist salt-tolerant species, including the nationally rare Holy Grass *Hierochloe odorata.*

Saltpans and **creeks** are usually species poor, but on their fringes can be found Saltmarsh Flat Sedge *Blysmus rufus,* Brackish Water Crow-foot *Ranunculus baudotii and* Sea Purslane *Atriplex portulacoides*, the latter at the northern edge of its range.

3.3 Reptiles and Amphibians (high importance)

More than 15% of the UK population of the internationally uncommon Natterjack Toad *Epidalea calamita* is found in Dumfries & Galloway. In many parts of Britain this species is associated with sand dunes and lowland heaths, but at its northern limit in Britain the north Solway population is centred upon **upper saltmarshes** from east of Powfoot to Mersehead.

3.4 Invertebrates (high importance)

The invertebrate fauna is especially rich in the **upper saltmarsh** zone. Though most species are of terrestrial rather than marine origin, many are specialists in this habitat, including a spider *Pardosa purb*eckensis, and the ground beetles *Dyschirius nitidus, D. salinus, Bembidion minimum*, and *B. normannum*, which have all been recorded in Dumfries & Galloway.

The Tadpole Shrimp *Triops cancriformis* was known in Dumfries & Galloway from Southwick in 1945, but was considered lost when this area was eroded by the sea in 1960. It was rediscovered in a small seasonal upper **saltmarsh pool** at Caerlaverock in September 2004. It is known only from one other site in Britain, a single freshwater pond in the New Forest.

The commoner saltmarsh invertebrates provide food for large numbers of waders, wildfowl and other birds.

3.5 Fungi and Lichens (medium importance)

Saltmarsh provides a specialised habitat in which fungi play an important, though not obvious, role. A number of micro species are associated with saltmarsh plants and soil, and a few larger species and lichens also occur, although few are restricted to this habitat. In some areas there is a local tradition of collecting field mushrooms *Agaricus spp.* from the merse.

Tadpole Shrimp caught at Caerlaverock. October 2004. (Wildfowl & Wetlands Trust).

3.6 Non-flowering Plants (medium importance)

British saltmarshes support relatively few mosses and liverworts. A few species can tolerate the high salinity, such as *Hennediella heimii,* which is more frequent here than in any other habitat. **Lower saltmarsh** may be totally devoid of bryophytes, though the Solway provides virtually the only UK records of *Pseudephemerum nitidum* in this habitat. Most species are found in **mid to upper saltmarshes**, especially where grazed and flushed with freshwater.

Various microscopic algal species of the genus *Vaucheria*, are found on Solway saltmarshes sometimes forming large green mats. Most occupy slightly different niches, including **creeks** and brackish waters. Although under-recorded, some of these species are rare elsewhere in Britain.

3.7 Fishes (low importance)

The widely fluctuating salinity of **saltpans** restricts their use by fish, but juvenile Flounders *Pleuronectes flesus* are more tolerant than most and can sometimes be found in these pools, along with Three-spined Sticklebacks *Gasterosteus aculeatus*.

3.8 Mammals (low importance)

Brown Hares *Lepus europaeus* and other mammals are often seen on saltmarshes, but no species are particularly dependent on this habitat.

4. Environmental, Economic & Social Importance of Biodiversity

- Saltmarshes act as a valuable natural flood-defence, dissipating wave energy and reducing scour.
- Saltmarshes provide valuable grazing for sheep and cattle. In some areas saltmarsh lamb has been specifically marketed as a very high quality product.
- Wildfowling takes place on many saltmarshes in Dumfries & Galloway, with visiting wildfowlers providing economic benefits to local businesses during the winter months.

5. Factors affecting the Habitat

- **Grazing** by domestic stock has historically been practised on Dumfries & Galloway's saltmarshes, restricting many species to creek banks that are less accessible to livestock. High grazing pressure results in a short grassy sward favoured by geese, but previously grazed saltmarshes, if abandoned, become dominated by rank grasses in the mid to upper marshes, which have limited botanical diversity. Overgrazing by sheep is highly unsatisfactory for most invertebrates and most breeding birds.
- **Destruction of the natural terrestrial transition** affects many saltmarsh species that specialise in the upper zones of saltmarsh, some of which are only tidally inundated by the highest tides.
- **Cordgrass colonisation** of open mud in Auchencairn, Orchardton Bays, Fleet Bay, Nith Estuary and Rough Firth occurred rapidly during the late 20th century producing extensive monoculture swards of reduced wildlife value. This expansion continues, albeit at a slower rate. Some colonised areas have steadily built in height and progressively been transformed into more typical saltmarsh communities, though some new clumps of cordgrass have also been detected.
- **Erosion** has been rapid on some areas of saltmarsh in the region in recent years, though for the Solway as a whole accretion may be balancing erosion. At Eastpark, Caerlaverock there has been a substantial gain in pioneer saltmarsh, with 67ha accreting between 1999 and 2006 and no significant losses.
- Saltmarsh is vulnerable from **pollution** of the estuaries it fringes, particularly oil spills and subsequent clean up operations. Waste tipping, sewage effluent and agricultural run-off also alter the flora and fauna of the saltmarsh.
- **Wildfowling** can affect numbers of birds using saltmarshes to feed and roost.
- **Sea level rise** and maintenance of sea defences may cause coastal squeeze (loss of upper and lower habitat).

6. Strategic Actions

6.1 Recent and current activity

- Most saltmarsh in the region is within **SSSI designations**, with mechanisms in place to prevent deliberate losses of marsh.
- Saltmarshes are included within the **Solway European Marine Site** management scheme.
- **Scottish Natural Heritage** ran a Merse Management Scheme that aimed to integrate the needs of saltmarsh into local agricultural units. This Scheme has now been incorporated into the Scottish Rural Development Programme.
- Careful management of wildfowling is in operation in Dumfries & Galloway.
- 'New' marsh has been allowed to establish in places where retaining walls have been broken down, such as at Annan Waterfoot. In 2000, **The Wildfowl and Wetlands Trust** at Caerlaverock allowed 8ha of improved grassland to become seasonally inundated by the tide and thus change the composition of the sward, through a conscious decision not to maintain the sea wall.
- In 2001, **RSPB** completed an assessment of all larger saltmarshes in the region and provided advice on their management for breeding and wintering birds to landowners.
- **Historic Scotland** has completed an assessment survey of the coast including erosion and geomorphology and its potential impact on archaeology and paleoenvironmental aspects of the inner Solway.

6.2. Other recommended actions

- Allow undisturbed saltmarsh to undergo the **natural processes** of erosion, deposition and plant growth without intervention. In unmanaged saltmarshes, there will be a series of successional stages with a varied structure.
- **Avoid flood defence works, development, reclamation or agricultural improvement** on saltmarshes. The upper marsh will have the highest interest, but retain a full transition of vegetation types
- **Re-creation of saltmarsh** may be possible on a limited number of sites in the Solway by the breaching of sea walls or modification to allow ingress of tidal waters and encourage saltmarsh establishment. Accretion rates may also be increased or sediments stabilised at some locations in order to promote saltmarsh formation. However, there are no payments to support this at present and any plans would need to cater for a continuity of special niches. Managed realignment could raise particular problems with seepage marsh, where the hydrology may not adjust. Gains of saltmarsh using this method may be at the expense of open intertidal areas and upset local natural sediment patterns.

Saltmarsh cliff at Powfoot. July 2006. (Peter Norman)

COASTAL CLIFFS & SLOPES

Priority Action (CCS1)

Demonstrate integrated management for farming, biodiversity, recreation, and cultural heritage on coastal slopes through establishment of a coastal heath/grassland restoration pilot project, by 2012. Lead Partner: Solway Heritage/Farming & Wildlife Advisory Group/Regional Proposal Assessment Committee.

Rhins coast near Dunskey Castle. July 2006. (Peter Norman).

1. Habitat Description

1.1 Physical Characteristics

Coastal cliffs and slopes occur at the junction between land and sea, formed by land slippage and/or erosion by the sea. The underlying geology determines the variation in landforms, with vertical **hard cliffs** created by granite and sandstone. These are resistant to weathering and erosion, but may develop a range of microhabitats, including rock face vegetation and cliff crevices, as well as bare rock exposures. A few hard cliffs also have **sea caves**, some of which are flooded by the tides. **Soft cliffs,** derived from sand and clay deposits, are less stable, being actively eroded by both the sea and by freshwater running over them. They too often develop into a complex of small, distinct microhabitats.

Coastal heath near Dunskey Castle. August 2006. (Peter Norman)

Some sections of the coast have no vertical or near vertical cliffs at all, or the cliffs are interspersed with **coastal slopes.** These slopes are colonised by a variety of different communities, including **coastal heath**, **coastal grassland**, **coastal seepages**, **bracken,** and **coastal scrub and woodland.** Some of these, such as exposed maritime grasslands, are composed of many specialised species rarely found in the equivalent habitats inland, whilst in others, such as maritime woods, the main coastal effect is to modify growth form and habitat structure.

Flora and fauna is greatly influenced by exposure to the wind and salt spray, which is greatest close to the sea and least at the cliff top, although the influence of salt may extend up to 1km inland on the most exposed coasts. Aspect can have an important bearing on exposure as well as on sunlight, with southerly facing slopes often providing warm and sheltered hollows favoured by many invertebrates.

1.2 National and International Context

Sea cliffs occur discontinuously along the west facing coasts of Europe. The UK supports a significant proportion of EU sea cliffs and slopes, with approximately 4,650km, about half of which (2,373km) is found in Scotland.

2. Dumfries & Galloway Status

2.1 Recent Trends

Almost total abandonment of grazing on coastal slopes has occurred in recent decades, combined with intensification of farming on the cliff top. However, unlike many coastal cliffs and slopes in England, there are few coastal defences at cliff bases, and relatively little coastal development, caravan sites and car parks, though there are a number of moderately used coastal footpaths.

2.2 Current Distribution

Of Dumfries & Galloway's 350km of coastline, only very small areas of low **soft cliffs** occur, mostly in the inner Solway. **Hard cliffs** with vertical exposures are more typical of the outer Solway, extending very approximately to 11km. A further 97km is composed of **coastal slopes** with grassland, scrub and woodland, not including slopes behind raised beaches. **Coastal heath** occurs only in very small pockets, particularly on the Rhins. The maximum cliff height in Dumfries & Galloway is 110m at Dunman, near Mull of Galloway.

2.3 Site Examples

The **Mull of Galloway** (SAC/SSSI) is the most important site in the region for both plants and birds. Other important sites include **Portling to Castlehill Point** (part SSSI), **Balcary to Torrs Point** (SSSI), **Borgue Coast** (SSSI), **Burrow Head,** and the west coast of the **Rhins**. Important coastal scrub and woodland occurs at **Ravenshall** (SSSI) and **Southwick** (SSSI). The Solway islands – **Rough Island**, **Hestan Island**, **Little Ross** (SSSI), the **Islands of Fleet** (SSSI) and **Scare Rocks** (SSSI) all include coastal cliffs and slopes. Sea caves include **Barlocco Heughs, Dove Cave** and **Cave of Uchtriemackean.**

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with coastal cliffs and slopes, and the following action plans may also contain relevant information: Coastal Shingle Beaches, Coastal Saltmarshes (Merse), Waterfalls, Inland Rock Outcrops.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Hard cliffs support a limited range of species, but many are highly specialised and of restricted local and national distribution, including Rock Sea Spurrey *Spergularia rupicola*, Roseroot *Sedum rosea*, Scot's Lovage *Ligusticum scoticum*, Rock Samphire *Crithmum maritimum*, and Ivy Broomrape *Orobanche hederae*. Golden Samphire *Inula crithmoides* is found at its only Scottish location. Remnant examples of prostrate Juniper *Juniperus communis* occur on cliffs between Sandyhills and the Rhins. Ledges occupied by breeding seabirds develop a less important plant community, more able to cope with high nutrient levels. **Soft cliffs** are relatively botanically poor.

The various habitats of **coastal slopes** are botanically rich, with perhaps **coastal grasslands** being richest of all. Typically these support Thrift *Armeria maritima*, Sea Campion *Silene uniflora,* Bloody Cranesbill *Geranium sanguineum*, and Wood Vetch *Vicia sylvatica*, with Purple Milk-vetch *Astragalus danicus* and carpets of Spring Squill *Scilla verna* at some locations. Some of the more inaccessible grassy slopes support rare species such as Sticky Catchfly *Lychnis viscaria*, Purple Oxytropis *Oxytropis halleri*, Bithynian Vetch *Vicia bithynica*, Yellow Vetch *Vicia lutea,* Small Restharrow *Ononis reclinata*, and Sea Stork's-bill *Erodium maritimum.*

Typical species of **coastal heath** include Bell Heather *Erica cinerea,* Burnet Rose *Rosa pimpinellifolia* and Western Gorse *Ulex gallii*, the latter rare in the rest of Scotland. The rare Dotted Sedge *Carex punctata* is associated with **coastal seepages.**

3.2 Invertebrates (very high importance)

Soft cliffs are of outstanding national importance for invertebrates, but no studies have been made of the few sites that occur in Dumfries & Galloway.

The invertebrate fauna of **hard cliffs** is relatively modest in comparison, but where shallow trickles or films of water run over hard surfaces algae, mosses and liverworts form the base of the food chain for a small, but exceptionally specialised invertebrate assemblage including caddisflies, beetles, and flies. For example, a slender-footed fly *Liancalus virens* has been recorded in Dumfries & Galloway, but is more usually found in Devon and Cornwall. Some invertebrates are associated with carrion and guano from seabird colonies and, remarkably, the House Martin Flea *Ceratophyllus hirundinis* is almost entirely restricted to cliff nests, with just a few records from nests in coastal buildings.

Pointed Snails *Cochlicella acuta* are found on dry, grassy **coastal slopes**, mostly on the west coast of Britain, and have rarely been recorded more than a mile inland. The locally uncommon Bloody-nosed Beetle *Timarcha tenebricosa* has been recorded at Rough Firth, whilst records of the attractive, iridescent Rose Chafer *Cetonia aurata* are concentrated on the Rhins coast.

Coastal grassland is important in a Scottish and/or local context for some butterflies and moths, including Northern Brown Argus *Aricia artaxerxes*, Wall

Lasiommata megera, Grayling *Hipparchia semele,* Thrift Clearwing *Bembecia muscaeformis*, Forester *Adscita statices*, Crescent Dart *Agrotis trux* ssp. *lunigera* and Northern Rustic *Standfussiana lucernea.* The larvae of a micro moth *Agonopterix rotundella* feeds on Wild Carrot on coastal cliffs in Wigtownshire, its only Scottish location, but the Small Blue butterfly *Cupido minimus* is probably now extinct.

The nationally scarce spider *Talavera petrensis* has been recorded from **coastal heath** at the Mull of Galloway. The only other Scottish record is from Rum.

Virtually the entire Scottish populations of Speckled and Dark Bush Crickets *Leptophyes punctatissima* and *Pholidoptera griseoaptera* are found in areas of rough grassland with **coastal scrub** in Dumfries & Galloway. Scrub also provides valuable nectar sources for many insects. **Coastal woodland** may support invertebrates that are absent inland, such as the nationally scarce bark beetle *Dryocoetinus alni,* found at Ravenshall.

The Spiders *Meta menardi* and *Porrhomma convexum* are found in **sea caves**, whilst at Ravenshall is the rare cave-dwelling woodlouse *Trichoniscoides saerocensis*. Common invertebrates, such as Herald Moths *Scoliopteryx libatrix* are also occasionally found in sea caves.

3.3 Birds (very high importance)

Hard cliffs are most important for breeding birds, supporting nationally important numbers of Gannets *Morus bassanus*, Cormorants *Phalacrocorax carbo* and Lesser Black-backed Gulls *Larus fuscus* as well as regionally important numbers of Guillemots *Uria aalga*, Razorbills *Alca torda*, Shags *Phalacrocorax aristotelis*, Fulmars *Fulmarus glacialis*, Kittiwakes

Young Peregrine Falcons at Portpatrick. (Gordon McCall)

Soft, eroding cliffs are important for some invertebrates. Inner Solway, February 2008.(Richard Mearns).

Rissa tridactyla, Herring Gulls *Larus argentatus*, Great Black-backed Gulls *L. marinus*, and small numbers of Black Guillemots *Cephus grylle* and Puffins *Fratercula arctica*. Exceptionally high densities of breeding Peregrines *Falco peregrinus,* Ravens *Corvus corax* and, rarely, Choughs *Pyrrhocorax pyrrhocorax* also breed. Several colonies of cliff-nesting House Martins *Delichon urbica* occur.

Although a few birds will visit sea caves, and the scientific name of the Wren *Troglodytes troglodytes* means cave dweller, caves generally do not form an important bird habitat. Choughs will, however, nest in caves.

Coastal scrub supports perhaps the best populations of Linnets *Carduelis cannabina*, Stonechats *Saxicola torquatus*, Lesser Whitethroats *Sylvia carruca* and Common Whitethroats *Sylvia communi* in a local context. Small numbers of Twite *Carduelis flavirostris* breed on **coastal heath**.

3.4 Fungi and Lichens (high importance)

The fungal flora of coastal cliffs and slopes is rarely of major importance, usually consisting of species common in other habitats, but a broad array of lichens occurs in this habitat. In many cases quantity is more important than the quality, with some rock faces having 100% cover of typical species such as *Verrucaria maura, Caloplaca marina* and Sea Ivory *Ramalina siliquosa*. However, rare species have also been recorded including *Cladonia peziziformis* on **coastal heath** near Portpatrick, *Degelia ligulata* on rocks in **coastal seepages** at Portpatrick, *Caloplaca britannica* on nutrient-rich bird perching sites in the Rhins and *Sticta canariensis* on moist rocks or trees at Dirk Hatteraick's Cave. The **coastal woods** at Southwick and Ravenshall are particularly lichen rich.

3.5 Non-flowering Plants (high importance)

Seaside Grimmia *Schistidium maritimum* is a moss restricted in Britain to coastal rocks on northern and western coasts, usually in shallow crevices where there is some shelter or an occasional trickle of fresh water from above. It may also colonise artificial substrates. Above the influence of salt spray, there is a high diversity of mosses and liverworts, especially on cliff faces with gullies and freshwater seepages. Sea Spleenwort fern *Asplenium marinum* also finds a home in these damp crevices.

Sea caves, especially those not regularly flooded by the sea, can also be important for bryophytes. Light intensity is the critical factor here, but a few species are able to survive in the low light levels near cave entrances.

Dark Bush Crickets are at the northern edge of their range on the Galloway coast. Ravenshall, August 2007. (Richard Mearns)

On cliff tops Soft Shield Fern *Polystichum setiferum* is sometimes found, whilst Neat Crisp-moss *Tortella nitida* has been recorded in Kirkcudbrightshire. It is frequent on dry, sunny rock outcrops set just back from the sea in south west England and Wales, even forming extensive patches on wall tops in some coastal towns, but it is rare in Scotland.

3.6 Reptiles and Amphibians (high importance)

Coastal slopes support important populations of all three native reptiles, Adders *Vipera berus*, Slow Worms *Anguis fragilis* and Common Lizards *Zootoca vivipara*. Amphibians are of lesser importance in this habitat.

3.7 Mammals (low importance)

Several common species of mammal are found on **coastal slopes**. However, part of the importance of coastal cliff and slope stems from the fact much of it is free from the effects of grazing and predatory mammals.

4. Environmental, Economic & Social Importance of Biodiversity

- Coastal and marine habitats have an extremely high landscape and amenity value. Much of this habitat falls within National Scenic Areas and Areas of Regional Scenic Significance.
- Coastal cliffs and slopes have very high recreational value, and include some of the most well-walked footpaths in the region on the Colvend coast and at Balcary, Portpatrick and Mull of Galloway. The latter site includes a cliff top café.
- Coastal areas were of great importance to early people and, due to the relatively limited disturbance of such areas in recent years, many remain rich in archaeology.

5. Factors affecting the Habitat

- **Coastal protection works** prevent natural erosion processes. Hard rock faces and soft cliffs require no management.
- Reduction or cessation of **grazing** in some areas has caused an over-dominance of scrub on maritime grasslands. Overgrazing in other areas by sheep (and perhaps feral goats in a few areas) has caused a loss of plant diversity and removal of cover for nesting birds.
- Positioning of winter **cattle feeding stations** within the coastal strip reduces plant diversity.
- **Cultivation of cliff top vegetation** has truncated the natural transition between maritime and terrestrial vegetation resulting in a loss of plant diversity and limited interchange of some animal species between the coastal strip and inland areas.
- Drift from **herbicide and pesticide** sprays.
- **Burning** of gorse and other vegetation at inappropriate places and/or inappropriate times of year.

- **Eutrophication** associated with agricultural run-off and from seabird colonies, especially at Almorness and Murray Isles.
- **Clearance of rocky outcrops** and boulders to increase grazing areas.
- **Dumping** of farm rubbish and rubble.
- Inappropriate **forestry** has affected a few sites.
- Moderate use of footpaths by walkers can be of benefit, especially in the absence of grazing, but **excessive trampling** may cause damage.
- **Rock climbing** can disturb nesting birds or damage flora.
- Adjacent **developments** in the form of caravan sites and golf courses may increase disturbance and trampling.

6. Strategic Actions

6.1 Recent and current activity

- Monitoring of larger seabird colonies by **RSPB** and volunteers.
- Seabird ringing by **North Solway Ringing Group**.
- Monitoring of Peregrine and Raven breeding success by **Dumfries & Galloway Raptor Study Group**.
- Sticky Catchfly population enhancement by **SWT, SNH** and **Royal Botanic Garden Edinburgh**.
- SSSI notifications have given a degree of protection.
- Reserve status or similar provides protection, and in some cases management, at Southwick (**SWT**), Rockcliffe and Murray Isles (**NTS**).
- The **Mountaineering Council of Scotland** has produced an information sheet about birds and climbing, which contains guidance on responsible climbing.

6.2 Other recommended actions

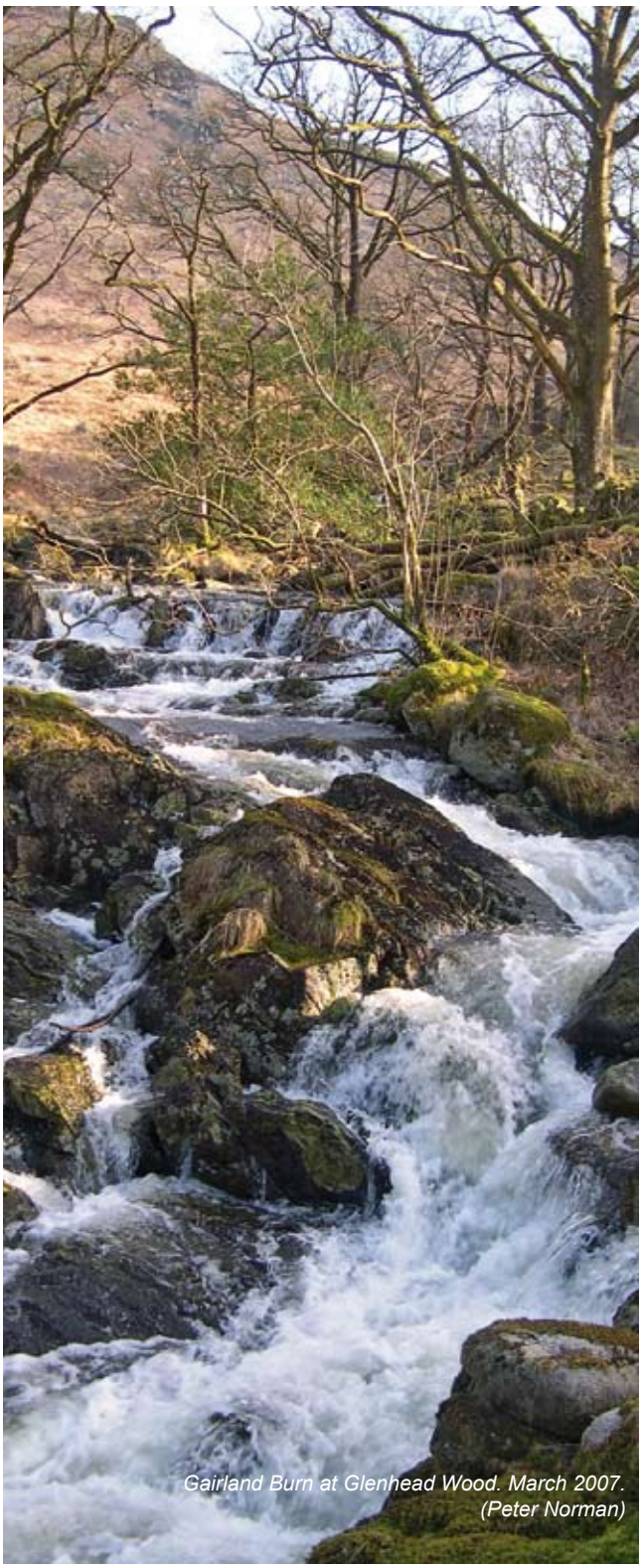
- Implement **Coastal Zone Management** strategies at local, regional and national levels.
- Encourage further **survey work and research** into the ecology of this habitat.

Sea Caves and cliffs. Barlocco, April 2007. (Richard Mearns)

RIVER HEADWATERS

Priority Action (RH1)

Encourage semi-natural habitats on the banks of river headwaters by fencing (and planting if necessary) to encourage regeneration of semi-natural habitats.
Target: 30km of river bank by 2015.
Lead Partner: Galloway Fisheries Trust/District Salmon Fisheries Boards/Regional Proposal Assessment Committee.



Gairland Burn at Glenhead Wood. March 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Most British rivers rise in the uplands. Their headwaters are high-energy environments that flow, with irregular velocity, over steep gradients. They are characterised by narrow **river channels** with rocky bottoms strewn with boulders and other coarse channel sediments. The water is colder than in lower reaches, low in nutrients but containing higher levels of dissolved oxygen and carbon dioxide.

River banks of headwaters tend to be steep and sparsely vegetated, resulting in a high input of sediments. Although historically the banks of river headwaters may have been well wooded, this is rarely the case today. **Coarse woody debris** consists of tree trunks, root boles, logs, branches and other pieces of partially submerged wood larger than 10cm in diameter and 1m in length. It supports a range of wildlife and though it naturally occurs throughout the course of rivers, because of the narrowness of the channels, it is most common in headwaters.

1.2 National and International Context

Headwaters are common throughout Europe. Upland headwaters in Britain are mostly found in the north and west.

2. Dumfries & Galloway Status

2.1 Recent Trends

Over the last 20 years a number of projects have begun to address historical impacts on river headwaters. These include the discouragement of overgrazing, overburning and moorland drainage through agricultural grant schemes; improved forestry techniques through the Forests and Water Guidelines; and the fencing of sections of headwaters, planting of native trees and stabilisation of eroding river banks, led by fish and angling interests.

2.2 Current Distribution

Most of the region's rivers have a north to south flow. River headwaters are therefore mostly located the Southern Uplands, in the north of the region.

2.3 Site Examples

All of the region's main rivers rise in the uplands and have important associated headwaters. Examples include **Tarf Water** (SAC/SSSI) for the River Bladnoch, **Water of Trool** and **Water of Minnoch** for the River Cree**, Big Water** and **Little Water of Fleet** for the River Fleet, **Water of Ken** and **Blackwater of Dee** for the River Dee, **Scaur Water** and **Carron Water** for the River Nith, and **Moffat Water** and **Water of Ae** for the River Annan.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with river headwaters, and the following action plans may also contain relevant information: Exposed River Shingle, Waterfalls, Upland Springs and Flushes, Blanket Bogs, Acid Grasslands, Inland Rock Outcrops, Upland Heaths, Native Wet Woods.

3. Importance for Associated Species

3.1 Fishes (very high importance)

The characteristic fish of river headwaters is the Brown Trout *Salmo trutta*. It thrives in the cold, well-oxygenated **river channels**. They, and their close

Salmon migrate upstream to spawn in the clean gravel beds of headwaters. (Laurie Campbell)

relative the Salmon *S. salar* require clean, silt free gravel beds in which to spawn. These beds, known as redds, are found upland headwaters as well as some lowland tributaries. Eels *Anguilla anguilla* are also typical of headwaters.

3.2 Non-flowering Plants (very high importance)

Due to the physical and chemical composition of river headwaters, algae, mosses and liverworts are often the dominant vegetation. Alpine Water-moss *Fontinalis squamosa* is one of the few mosses that actually grows in the water, usually in **river channels** with fast flowing water. It is recorded from several sites in Dumfries & Galloway including the River Cree, Water of Luce and Water of Ae.

On **river banks** there are many species and much variation between different watercourses, but typical bryophytes include: Yellow Fringe-moss *Racomitrium aciculare* in profusion on top of rocks in fast-flowing, base-poor headwaters; Fountain Apple-moss *Philonotis fontana* and Drab Brook-moss *Hygrohypnum luridum* by fast-flowing burns in the uplands; Water Earwort *Scapania undulata* often prominent by acid burns; and Transparent Flapwort *Jungermannia hyalina* commonly found on gritty rock ledges near water-level in stream gullies or on boulder tops in rocky rivers. On shaded damp rocks and trees, including in deep headwater valleys, is found the locally rare Wilson's Filmy-fern *Hymenophyllum wilsonii*. Tunbridge Filmy-fern *Hymenophyllum tunbrigense* occurs in similar habitats, but is very rare, possibly extinct in the region.

3.3 Invertebrates (very high importance)

Invertebrates of shallow fast-flowing waters include water bears, mayflies, caddisflies, blackflies and molluscs. The region's largest common dragonfly, the Golden-ringed *Cordulegaster boltonii* is even able to breed in such habitats. Most of these creatures live under stones and/or have flat bodies to reduce resistance to the current.

A number of notable aquatic invertebrates have been recorded in headwater **river channels** Dumfries & Galloway, including a water beetle *Hydraena pygmaea* under mossy boulders in steep streams in Galloway, with recent records from only three 10km squares

Golden-ringed Dragonflies breed in the flowing waters of headwater burns. Garroch Glen, July 1999. (Peter Norman)

Coarse woody debris in Water of Trool. Caldons, May 2006. (Peter Norman)

in Scotland. All Scottish records for River Skaters *Aquarius najas* relate to Galloway, including Water of Trool and Blackwater of Dee. The next nearest populations are in North Wales. Freshwater Pearl Mussels *Margaritifera margaritifera* once occurred in most of the region's headwaters, but now only small and vulnerable populations of this rare mollusc survive. Their larvae grow for almost a year attached to the gills of salmonid fish.

Although little research has been carried out in the UK, extensive studies in North America suggest **coarse woody debris** is of high importance for a range of specialist invertebrates. These feed directly on wood, or on the algae, bacteria and other materials on the surface of wood, or indirectly benefit from the changes coarse woody debris has to the river and stream structure. Coarse woody debris is particularly important for craneflies, with *Lipsothrix errans* particularly notable in Dumfries & Galloway. Deep pools immediately downstream of coarse woody debris dams also support mayflies *Ephemeroptera*.

A number of invertebrates, such as a ground beetle *Bembidion atrocoeruleum*, are associated with **river banks** of upland streams across the region. Overhanging vegetation on the river banks also provides an important source of invertebrate food for fish.

3.4 Birds (medium importance)

The characteristic bird of river headwaters is the Dipper *Cinclus cinclus*, which feeds underwater on mayfly and caddisfly larvae. Goosanders *Mergus merganser*, Common Sandpipers *Actitis hypoleucos* and Grey Wagtails *Motacilla cinerea* also occur.

3.5 Fungi and Lichens (medium importance)

A number of fungi, mostly micro species, are specifically adapted to river habitats. Some are specialist wood-rotters that create suitable conditions in **coarse woody debris** for invertebrates to colonise. The largest and most obvious species is the uncommon *Vibrissea truncorum*, recorded from the River Cree.

A greater range of lichens occurs on headwaters than on lower stretches of rivers, though few are restricted to this habitat. The most important areas are bouldery stretches or waterfalls, where there is much exposed rock.

3.6 Mammals (medium importance)

Water Voles *Arvicola terrestris* have declined substantially in Britain, especially in lowland areas. Although fast flowing rocky headwaters with little vegetation is a poor habitat for Water Voles, slower flowing stretches with bankside cover may provide the best remaining Water Vole habitat in the region.

3.7 Flowering Plants (low importance)

Most flowering plants are unable to gain a foothold in the **river channel** of headwaters. **River banks** are also generally species poor, though in some marshy areas with low grazing pressure species such as Grass of Parnassus *Parnassia palustris*, Heath Spotted Orchid *Dactylorhiza maculata* and Bog Asphodel *Narthecium ossifragum* occur, along with thickets of willow, including the locally scarce Dark-leaved Willow *Salix myrsinifolia*. Serrated Wintergreen *Orthilia secunda* is an evergreen herb of pine and birch woods, open moorland and on ledges in rocky gullies and stream banks, mainly in the Highlands. It was recorded at Grey Mare's Tail (Moffat) in the 1950s and next to Caldons Burn in 1962, but has not been relocated at either location.

4. Environmental, Economic & Social Importance of Biodiversity

Headwaters exert a major influence on the hydrology and quality of rivers downstream, affecting issues such as drinking water, flooding, soil erosion and fishing.

5. Factors affecting the habitat

- **Acidification**, caused by atmospheric emissions from industry and transport in other parts of the country/world. Those in the west of the region such as the Luce, Cree, Bladnoch, Fleet and Dee, have been most severely affected due to heavy rainfall levels, poor buffering capacity of the bedrock and the capacity of extensive conifer plantation to capture atmospheric pollutants.
- Prior to the implementation of recent guidelines, **conifer planting** often occurred right up to the edge of watercourses, and some of these trees still remain. They cast a heavy shade, limit vegetation growth, and expose the banks to erosion.

An aquatic lichen Dermatocarpon luridum, found on rocks in upland burns. Tarff Water, May 2008. (Peter Norman)

- Many of the upland **drainage** systems installed in the last century still operate, affecting the capacity of upland areas to mitigate peak headwater flows.
- High turbidity levels due to **inputs of fine sediments** such as clay, silt and fine sands resulting from poor management of cultivation, drainage, road building and timber harvesting. This reduces aquatic light levels, biomass productivity, fish feeding and migration, and when it settles it damages fish spawning areas.
- **Nutrient enrichment** following large scale forestry felling or application of fertiliser.
- Pollution through **agricultural and forestry chemicals or oil**, though generally not significant in the region, has the potential to pose a localised threat to headwater biodiversity.
- **Removal of coarse wood debris**, as this is often seen as potentially hazardous. Watercourses containing high amounts of coarse woody debris are therefore uncommon.

6. Strategic Actions

6.1 Recent and current activity

- Many of the factors affecting the habitat resulting from forestry practices are addressed through the Forest and Water Guidelines. In particular, forest restructuring is minimising the impact of acidification.
- River catchment plans have been completed for the Bladnoch, Nith, Annan and Dee-Ken catchments.
- As part of the Water Framework Directive, a River Basin Plan for the Solway-Tweed is in preparation and will be published by December 2009.

6.2 Other recommended actions

- Establish **more native broadleaves** along the banks of headwaters.
- **Archaeological sites** and other important features of the historic landscape may be more frequent in the uplands. Identify all such sites and ensure habitat works protect and, where possible, enhance them.
- **Carefully plan and execute all road building** in forests and other areas in the vicinity of headwaters, including choice of materials, timing of work and ongoing operational requirements. Consultation with all relevant organisations is essential.
- **Do not culvert** headwaters wherever possible.

LOWLAND RIVERS & BACKWATERS

Priority Action (LRB1)

Assess the feasibility of restoring or reinstating a river backwater system, and encourage this where appropriate.

Target: Identify potential sites for backwater restoration on one of the region's major rivers by 2012, avoiding sites currently of high biodiversity or historical importance.

Lead Partner: Scottish Environment Protection Agency/Regional Proposal Assessment Committee.

Seasonal backwater on Water of Ae, August 2004. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

The nature of lowland river channels is dependent on the properties of the bedrock over which it flows, the nature of the flow itself, and the type and quantity of sediments it carries. Lowland rivers are highly dynamic systems: As water works its way downstream, materials are constantly transported and rearranged, meanders migrate, banks erode, new channels form and old ones are cut off. Instream and riparian wildlife has adapted to the natural flow regimes associated with individual rivers, and most rivers encompass a wide variety of habitats. The highest biodiversity occurs on unmanaged lowland rivers, particularly those associated with extensive backwater systems.

The **channel bed** in lowland rivers may be composed of a wide variety of sediment sizes from cobbles and gravels, through to silt, clay and alluvium. **Riffles**, where shallow water flows rapidly over coarse gravels, stones or boulders, are natural in-channel formations. They are constantly being reprofiled by floods so a constant supply of material is needed to maintain them. Riffles often occur in association with **pools**, areas of deeper slow-flowing water, and **runs**, where deep water flows swiftly. They are important for a range of aquatic biodiversity.

In-stream and riparian vegetation is vital for a healthy and sustainable ecosystem, especially where a watercourse has little variation in physical structure. It fulfils many functions, including water purification, nutrient re-cycling, riverbank stability and erosion protection, modification of flows, and provision of shelter, shade and food for many species.

Backwaters may be connected to the main channel at both ends and therefore have a continuous, if reduced flow; connected only at the downstream end; or lack any permanent connection to the main channel at all, such as in oxbows. The latter are usually influenced by floods to some extent. Backwaters act as refuge areas during periods of pollution.

Eroding **bankside cliffs** often occur on the outside of meanders. Though excessive erosion is damaging, the presence of some erosion features is a necessary part of river systems. Banks of exposed sand, silt and mud are also important for specialised biodiversity.

Gravel bars are included in a separate action plan for Exposed River Shingle

1.2 National and International Context

Lowland rivers are widespread throughout Britain and Europe. Similar river habitats to those found in Dumfries & Galloway are found on hard rocks in south-west England, Wales, northern England and many parts of Scotland.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been a recent trend towards more natural techniques of river engineering, though the majority of hard engineering river defences installed in the past are still operational across the region.

2.2 Current Distribution

As most of Dumfries & Galloway's rivers flow from north to south, most stretches of lowland river habitat is located in the south of the region.

2.3 Site Examples

The main rivers in Dumfries & Galloway are, from west to east, the **Water of Luce**, **River Bladnoch, River Cree, Water of Fleet, River Dee, River Urr, River Nith, River Annan, Kirtle Water, River Sark** and **Border Esk**. All have high biodiversity value, though also have some areas of degraded habitat along their course.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with lowland rivers and backwaters, and the following action plans may also contain relevant information: Exposed River Shingle, Lowland Burns and Ditches, Waterfalls, Reedbeds, Swamps, Native Wet Woods.

3. Importance for Associated Species

3.1 Fishes (very high importance)

Under the Fresh Water Fisheries Directive, 75% of Dumfries & Galloway's watercourses are designated salmonid waters, capable of supporting Atlantic Salmon *Salmo salar* Salmon and/or Sea/Brown Trout *S. trutta*. The other 25% of watercourses are designated as ciprinid waters. This designation includes whole catchments and not just the main rivers. Indeed, many of the minor tributaries provide the redds where salmonids spawn and are an integral part of the overall catchment.

Most freshwater fish are opportunist feeders, but salmon are especially dependent on aquatic insects and crustaceans, whilst trout and other species rely on invertebrates associated with **in-stream vegetation** or that have fallen in the water from **riparian vegetation**. Eels *Anguilla anguilla* are found in a wide range of freshwaters, but seem to prefer slow moving lowland rivers with muddy bottoms and plenty of bank side vegetation. **Backwaters** are important refuges for young fish from the current of the main flow.

Most coarse fish such as Pike *Esox lucius* and Perch *Perca fluviatilis* lay their eggs on **in-stream vegetation**. Others such as Minnows *Phoxinus phoxinus* use gravely areas, such as the tail-end of **riffles**.

Sparling (otherwise known as Smelt) *Osmerus eperlanus* spend most of their life in the sea, but require unpolluted water and a sandy or gravely channel bed for spawning, around the upper limit of the tidal influence. They have declined enormously in Britain, the River Cree being one of the few remaining spawning rivers. Important populations of Allis Shad *Alosa alosa*, Twaite Shad *Alosa fallax* and lampreys are also found in the region's rivers.

3.2 Invertebrates (very high importance)

Lowland rivers support very high numbers of invertebrates – 10-15,000 per square metre of **channel bed**. Each species is well adapted to its environment. For example on rocky beds mayflies of the genus *Ecdyonurus* have strong limbs to enable them to cling onto the undersides of rocks, whilst stonefly nymphs search out crevices where turbulence is reduced. Gravel, sand and silt beds support fewer species, but burrowing invertebrates such as non-biting midge larvae occur in high density.

A large number of water beetles are associated with lowland rivers, particularly exposed **mud and silt banks** in slow flowing stretches and backwaters: *Hygrotus versicolor* was found in the River Dee in 1996, its only Scottish location; *Bidessus minutissimus,* a nationally rare species has been found in fine silt, often among plant roots, at the edge of the River Nith at Lochside; *Hydraena pulchella* occurs in clean silt on the river edge, currently known from only four rivers in Scotland; and *Heterocerus marginatus* on mud banks beside the River Urr, known from only three rivers in Scotland. Other important invertebrates of river sediments include a cranefly *Nephrotoma guestfalica* of shaded sandy banks at two sites in Dumfriesshire, out of only four in Scotland.

Emergent vegetation in **backwaters** perhaps supports the most diverse range of invertebrates, with large numbers of water fleas, caddisfly larvae,

water beetles, damselflies and water snails. The latter group includes the Flat Valve Snail *Valvata cristata,* uncommon in Scotland and restricted to well oxygenated, slowly flowing or still water with rich vegetation, especially in quiet clean backwaters.

3.3 Non-flowering Plants (high importance)

The long fronds of Greater Water-moss *Fontinalis antipyretica* are a familiar sight in **pools** and **runs** on most of the region's rivers. It is the world's largest moss. Other typical bryophytes of riverside rock or gravel include Yellow Fringe-moss *Racomitrium aciculare,* Long-beaked Water Feather-moss *Rhynchostegium riparioides*, Brook-side Feather-moss *Amblystegium fluviatile* and Water Earwort *Scapania undulata.*

Riparian vegetation supports fewer specialist species than riverside rock, but several species have been recorded in association with the silt that accumulates on tree trunks in the flood zone. These include Many-fruited Leskea *Leskea polycarpa* and River Bristle-moss *Orthotrichum rivulare.* The nationally scarce Spruce's Bristle-moss *Orthotrichum sprucei*, a riverside epiphyte of Alder, Ash, and willow where occasionally inundated, has been recorded beside Cargen Water, near Dumfries.

3.4 Flowering Plants (high importance)

Rivers with floating mats of water crowfoots, including Stream Water Crowfoot *Ranunculus penicillatus* ssp. *pseudofluitans and* Pond Water Crowfoot *R. peltatus,* are considered particularly valuable, both in their own right and in terms of the shelter and food they provide for fish and invertebrates. Other mid stream species include Yellow Water-lily *Nuphar lutea,* Intermediate Water-starwort *Callitriche hamulata* and various pondweeds and water-milfoils.

Purple Loosestrife, a typical plant of lowland river banks. River Dee at Threave, July 1994. (Peter Norman)

Otters are found on all of Dumfries & Galloway's rivers. (Laurie Campbell)

3.5 Mammals (high importance)

Otters *Lutra lutra* occur on all watercourses in Dumfries & Galloway, but those with abundant **in-stream and riparian vegetation** support highest population densities. Bankside tree roots, especially oaks, Ash and Sycamore are of great importance as holt sites. Water Voles *Arvicola terrestris* are now rare on lowland rivers in Dumfries & Galloway, probably due to predation by American Mink *Mustela vison*. They also prefer tall and luxuriant bankside vegetation, but it must not be excessively shaded by trees and shrubs. Water Shrew *Neomys fodiens* distribution is poorly known, but vegetation cover is essential. All bat species hunt over waterbodies, but Daubenton's Bats *Myotis daubentonii* are specialist hunters low over slow flowing open water, preferring watercourses more than 9m wide and sheltered by overhanging trees.

3.6 Birds (high importance)

For many of the birds that use rivers as breeding and feeding grounds, **in-stream and riparian vegetation** in the form of emergent plants, terrestrial herbs, scrub and trees is a fundamental component, providing cover, food and nesting sites. Mallards *Anser platyrhynchos* and Moorhens *Gallinula chloropus* are able to nest on most rivers, but Little Grebes *Tachybaptus ruficollis* rely on an abundance of vegetation and are often restricted to backwaters, whilst Goosanders *Mergus merganser* need hollow trees. Kingfishers *Alcedo atthis* and Sand Martins *Riparia riparia* dig nest burrows in steep or vertical sandy **bankside cliffs** over water. Many stretches of lowland rivers are also important for wintering wildfowl, especially species such as Teals *Anas crecca* and Goldeneyes *Bucephala clangula*.

3.7 Reptiles and Amphibians (medium importance)

Common Frogs *Rana temporaria* and Palmate Newts *Lissotriton helvetica* have been known to breed in quiet **backwaters**, but the commonest amphibian in river habitats is the Common Toad *Bufo bufo*, which wraps it strings of spawn around plants in still or slow flowing water up to 30cm deep.

3.8 Fungi and Lichens (medium importance)

A number of fungi, mostly micro species, are specifically adapted to river habitats, and play an important role in the decay of submerged leaves. Their spores are abundantly found in river foam, and a few species are known only from this source.

4. Environmental, Economic & Social Importance of Biodiversity

- Angling for salmon and other freshwater fish in Dumfries & Galloway provides a major source of income to local economies and is a highly significant component of local employment patterns, both directly and in related tourist industries.
- Rivers and streams provide a wildlife corridor link between fragmented habitats in intensively farmed areas. This is particularly the case in the lower reaches of the rivers Dee and Urr.

5. Factors affecting the Habitat

- In the west of the region **acidification** of watercourses such as the Luce, Cree, Bladnoch, Fleet and Dee has led to loss of Salmon and/or Trout populations.
- **Changes in flow patterns** by forestry and other land uses in river catchments has affected fish stocks in areas of Galloway.
- **Land drainage and flood defence works**, if not sensitively carried out, can reduce riverine habitats, isolate streams from their floodplains and reduce river productivity. Dredging the channel bed with a mechanical digger increases suspended sediment load and turbidity for some distance downstream. In the long term it can destroy or disrupt features such as pools, riffles, point bars, floodplains and bankside vegetation. Settling out of the material in suspension will alter composition of the substrate. Disposal of soil from dredging on land may also be damaging.
- Agriculture and other **point source and diffuse discharges** have adversely affected rivers.
- **Sewage treatment works** are unable to treat some chemicals which are detrimental to fish and invertebrate species.
- **Accidental pollution spills** from various sources including agricultural slurry, silage effluent, sheep dip, and industrial products such as oil, can have a drastic impact.
- **Construction/engineering** projects, such as roads, urban development and mineral extraction, have led to modification of natural river systems.
- **Urban development**, including industry and housing, has the potential to affect run-off quantity and quality into rivers.
- The construction and operation of **dams and reservoirs**, such as those in the Ken-Dee Hydro Scheme, affects rivers and their biodiversity.
- Although limited livestock access along certain reaches can produce muddy margins beneficial for birds and invertebrates, **removal of woodland, bankside scrub and overwintered vegetation** through grazing or agricultural cultivation dramatically reduces the suitability of a river stretch for many species. Vegetation removal to provide better access for anglers is also carried out, but this is rarely beneficial for the conservation of biodiversity.
- Introduction of **North American Signal Crayfish** *Pacifastacus leniusculus* undermines riverbanks and consumes large amounts of aquatic vegetation, disrupting the ecological balance of rivers. Introduction and spread of other invasive plant and animal species, including non-native fish via live bait, also affects the habitat.
- Excessive **ground water and surface water abstraction** has the potential to cause damage.
- **Recreational disturbance**, such as canoeing and angling may have localised impacts.
- **Lack of education** about catchments and their use, problems and current action has led to unnecessary damage.

Backwater pools and willows on River Nith at Dalscone, January 2007. (Peter Norman)

6. Strategic Actions

6.1 Recent and current activity

- The EU Water Framework Directive requires integrated catchment management across the European Union.
- Catchment management plans have been produced for the Annan, Nith and Dee-Ken systems, co-ordinated by **SEPA**.
- River habitat enhancement schemes have been undertaken by bodies such as the **Nith District Salmon Fishery Board, The River Annan District Salmon Fishery Board** and **Galloway Fisheries Trust.** These schemes have included exclusion of livestock through fencing, planting of stabilising deciduous trees, sensitive bankside protection methods, and sensitive instream works to diversify substrate and flow types.
- Monitoring of the hatchery release programme on rivers Luce, Bladnoch, Cree, Fleet, Dee, Nith and Piltanton Burn by **Galloway Fisheries Trust** or **District Salmon Fisheries Boards**.
- Education of public value and sensitivity of rivers and the species they support, through for example 'Salmon in the Classroom' primary school projects.
- The ecology of rare fish, particularly Sparling, Allis Shad, Twaite Shad and lampreys has been studied on the Cree by **Galloway Fisheries Trust, SNH**, consultants and universities.
- Water quality, hydrology and salmonid production are monitored by organisations such as **SEPA, Galloway Fisheries Trust** and **District Salmon Fisheries Boards**.

6.2 Other recommended actions

- Meet and maintain the **Good Ecological Status** (according to Scottish Environment Protection Agency River Classification System) in all of the region's rivers.
- **Reduce pollution** in watercourses through more effective treatment of effluent and alternative disposal methods. Encourage the creation of buffer habitats adjacent to watercourses.
- Where bank stabilisation is necessary, use environmentally sensitive materials and **soft engineering techniques** wherever possible.
- Ensure that adequate **consultation** takes place when developments are proposed in river catchment systems.
- Take care to avoid any actions that may result in the spread **non-native invasive species**. Eradicate existing non-native invasive species where this is feasible and resources allow.

LOWLAND BURNS & DITCHES

Priority Action (LBD1)

Raise awareness of the importance of small burns and ditches through publications, demonstration days and farm visits.
Target: Make direct contact with 500 farmers by 2012.
Lead Partner: Scottish Environment Protection Agency/Farming & Wildlife Advisory Group.

Varied riparian habitats including Alders, shingle, pools and riffles on the Crichope Burn. June 2007. (Peter Norman).

1. Habitat Description

1.1 Physical Characteristics

Lowland burns and ditches usually contain slow-flowing water that is high in nutrients and relatively warm for much of the year. They have a relatively narrow channel width and often have muddy bottoms with dead leaves and other decaying plant material, and dense aquatic, emergent and marginal vegetation.

Ditches that are obviously man-made are included in the action plans for other habitats. However, many lowland burns have been modified by straightening and deepening to such an extent that they are indistinguishable from ditches. Many of these are managed for land drainage purposes and much of the information in this plan is relevant. **Canals** share many of the same characteristics as ditches and small lowland watercourses.

1.2 National and International Context

Small watercourses and ditches are common throughout lowland Britain.

2. Dumfries & Galloway Status

2.1 Recent Trends

Few new open ditches are being created today – recent drainage systems tend to use piped drains.

2.2 Current Distribution

Small burns and ditches are common in lowland areas of Dumfries & Galloway. Most are linked to larger rivers, but a number of lowland burns flow directly into the sea, without entering a major river.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with lowland burns and ditches, and the following action plans may also contain relevant information: Lowland Rivers and Backwaters, Fens, Marshes, Native Wet Woods, Conifer Plantations.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

Ditches and pools in the shade support a different fauna from that in open situations. Some species have aquatic larvae in ditches full of saturated organic mud. The Moss Bladder Snail *Aplexa hypnorum* is rare in Scotland and declining in the UK, but has been recorded in Kirkcudbrightshire. It occurs in weed-choked ditches, but rarely in 'higher quality' freshwaters. A number of dragonflies breed in burns and ditches, including Emerald damselfly *Lestes sponsa* and Banded Demoiselle *Calopteryx splendens*. The latter species, which prefers slow-flowing, muddy-bottomed watercourses, was discovered for the first time in Scotland in Kirkgunzeon Lane in 2004. It has since been found in another small burn close-by.

3.2 Mammals (high importance)

Although detailed survey information is lacking, lowland burns and ditches are probably the most important habitat in the region for Water Voles *Arvicola terrestris* and Water Shrews *Neomys fodiens.* Otters *Lutra lutra* also use surprisingly small

watercourses for feeding and movement, sometimes with just a few centimetres of water.

3.3 Fishes (high importance)

Typical fishes of small slow flowing watercourses include Three-spined Sticklebacks *Gasterosteus aculeatus,* Eels *Anguilla anguilla* and Brook Lampreys *Lampetra planeri.* Lowland burns and ditches may also be important for spawning and juvenile fish, even if there are few adult fish. They can be particularly important for Trout *Salmo trutta.*

3.4 Flowering Plants (high importance)

A high diversity of plants occurs in lowland burns and ditches, and all available microhabitats are usually colonised. For example, there are submerged species such as Spiked Water-milfoil *Myriophyllum spicatum* and Various-leaved Water Starwort *Callitriche platycarpa*; plants with leaves that float on the water surface such as Common Duckweed *Lemna minor* and Pondweeds *Potamogeton* spp.; plants in shallow water such as Brooklime *Veronica beccabunga* and Watercress *Rorippa nasturtium-aquaticum*; and emergent plants such as Reed Canary Grass *Phalaris arundinace* and bur-reeds *Sparganium* spp. Few rare species occur, but Round-leaved Water Crowfoot *Ranunculus omiophyllus* is not common in Scotland outside of the south west.

Ditch with range of aquatic vegetation, Cree Valley. June 2006. (Peter Norman)

3.5 Reptiles and Amphibians (medium importance)

Common Toads *Bufo bufo*, Common Frogs *Rana temporaria*, Smooth Newts *Lissotriton helvetica* and Palmate Newts *Lissotriton helvetica* commonly breed in slow flowing burns and ditches.

3.6 Non-flowering Plants (medium importance)

Algae play an important role in the ecosystem of lowland burns and ditches. Most are single-celled species, but filamentous green algae, such as *Spirogyra*, are also common.

Bog Beacon Mitrula paludosa, found on rotting leaves in ditches in Spring. Slogarie, April 2008. (Peter Norman)

3.7 Fungi and Lichens (medium importance)

A number of fungi grow on submerged leaves in stagnant conditions in ditches. They play an important role in the decay process. The most obvious of them is Bog Beacon *Mitrula paludosa*, which produces orange fruit bodies in late spring.

3.8 Birds (low importance)

Moorhens *Gallinula chloropus* and Sedge Warblers *Acrocephalus schoenobaenus* are among the common breeding birds in marginal vegetation beside lowland burns and ditches. Herons *Ardea cinerea*, Snipe *Gallinago gallinago* and Green Sandpipers *Tringa ochropus* visit to feed; the first two throughout the year, the latter mostly on its migration through the region in the autumn.

4. Environmental, Economic & Social Importance of Biodiversity

- Most agricultural and urban drains feed into minor watercourses rather than larger rivers. Without them, land drainage would cease to operate. Some also provide drinking water for livestock.
- The network of burns and ditches enhances the landscape.

5. Factors affecting the Habitat

- A **perception** that minor watercourses and ditches are no more than drainage channels hinders their conservation.

- **Culverting** ditches and small watercourses virtually eliminates their biodiversity interest.
- **Mechanised dredging** or 'cleaning' of small watercourses is frequently carried out. There has been little assessment of the long-term biodiversity impact of such works.
- Though they are naturally rich in nutrients, additional **nutrient enrichment** through agricultural operations causes loss of biodiversity.
- Due to their widespread distribution, **pollution** often enters larger watercourses via small burns and ditches. Pollution sources include slurry, pesticides, road run-off and sewage discharges.
- North American **Mink** are widespread and may exert a serious impact on fish, bird and especially Water Vole populations.

Steep, but well-vegetated banks on Abbey Burn, near Dundrennan. June 2006. (Peter Norman)

6. Strategic Actions

6.1 Recent and current activity

- **Galloway Fisheries Trust** and **Solway Heritage** carried out an ecological assessment of selected small watercourses that run directly into the sea.
- Training days have been organised by **SEPA** and the **Farming & Wildlife Advisory Group**, as part of the Dee-Ken Catchment Management Plan, to demonstrate good practice.

6.2 Other recommended actions

- Highlight the importance of even the smallest burn or ditch in terms of the biodiversity it supports and its linkages it has with other wetlands.

WATERFALLS

Priority Action (WF1)

Raise awareness of the biodiversity importance of waterfalls, by producing a guide to the waterfalls of Dumfries and Galloway.
Lead Partner: Dumfries & Galloway Biodiversity Partnership

1. Habitat Description

1.1 Physical Characteristics

Spout of Achentallach, near Twynholm. May 2008. (Peter Norman)

Waterfalls usually form due to differential erosion of the bedrock, either due to faults and other weaknesses, or to different rock types, but some were also formed when glaciers gouged out wide U-shaped valleys, leaving the feeder streams hanging above them. Although the public perception of waterfalls is of high, spectacular landscape features, low waterfalls have similar environmental conditions and support similar biodiversity.

The water flowing over waterfalls can vary from a trickle to a torrent, depending on weather conditions. The rock over which the water flows is usually polished smooth by the erosive force of the water. In the **spray zone** a cloud of fine spray results in damp conditions immediately adjacent to the falls, but overhangs and crevices behind and beside the falls are cushioned from environmental extremes and receive constantly low light levels, high humidity and frost free conditions. At the base of the falls, the **plunge pool** is usually one of the deepest parts of the river.

1.2 National and International Context

Waterfalls tend to be concentrated in the uplands, and therefore occur more frequently in the west and north of Britain.

2. Dumfries & Galloway Status

2.1 Recent Trends

There is no evidence of significant recent changes to Dumfries & Galloway's waterfalls.

2.2 Current Distribution

Waterfalls occur along all parts of most of the region's watercourses. They are most frequent in the headwaters and on the Galloway coast, where watercourses often flow over raised beach slopes immediately before entering the sea.

2.3 Site Examples

The highest and best known of the region's waterfalls is **Grey Mare's Tail** in Moffatdale (SAC/SSSI). Others include **Grey Mare's Tail** on a tributary of the Palnure Burn and **Holy Linn** on the Garple Burn near Dalry. On the coast are the **Black Burn Waterfall** near Lot's Wife at Southwick, and various falls around the Rhins peninsula.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with waterfalls, and the following action plans may also contain relevant information: Coastal Cliffs and Slopes, Headwaters, Lowland Rivers and Backwaters, Lowland Burns and Ditches, Inland Rock Outcrops, Upland Springs and Flushes.

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Both felt-forming and filamentous blue-green algae thrive in the conditions created by waterfalls. Genera such as *Chamaesiphon* and *Homoeothrix* form flat crusts on rock surfaces; slimy brown and green filaments of *Phormidium* frequent the lips of the falls; tough, leathery tufts of *Tolypothrix* have the ability to fix nitrogen in nutrient-poor upland areas; and red *Lemanea* is common on many waterfalls in the spring.

Waterfalls in rocky ravines in the uplands have an extremely rich liverwort flora, though the species tend to be very small in stature. Several species of *Nardia, Marsupella* and *Scapania* grow tightly pressed to the rock surface to avoid being dislodged. Less common species include Pale Scalewort *Radula voluta* recorded by a waterfall in Garlies Wood, and Shining Flapwort *Jungermannia paroica* at several

locations, often on very wet rock ledges or on rocks in the water. The latter species is largely restricted to Wales, Northern England and Scotland. Mosses are more common on lowland waterfalls. Holt's Mouse-tail Moss *Isothecium holtii,* a distinctive moss restricted to western Britain, requires high humidity and is frequently found by waterfalls.

On shaded rocks in the **spray zone** there are several ferns that benefit from the high humidity. These include the locally rare Wilson's Filmy-fern *Hymenophyllum wilsonii*. Tunbridge Filmy-fern *Hymenophyllum tunbrigense* occurs in similar habitats, but is very rare, possibly extinct, in the region.

3.2 Invertebrates (medium importance)

Few invertebrates are waterfall specialists, but saturated moss and surfaces constantly kept wet by waterfalls or fast-flowing streams may support populations of rove beetles, including *Dianous coerulescens* and *Lesteva pubescens* at their northern distribution limit on the Urr Water. Mayflies, stoneflies and caddisflies also occur. Aquatic invertebrates above waterfalls benefit from reduced fish numbers.

3.3 Flowering Plants (medium importance)

Virtually no flowering plants are able to withstand the harsh environment of waterfalls, but in the **spray zone** a number of species, such as Bog Pimpernel *Anagallis tenella* take advantage of the humid conditions. Purple Saxifrage *Saxifrago oppositifolia* occurs on only two sites in Dumfries & Galloway, one of which is beside the Grey Mare's Tail in Moffatdale.

Purple Saxifrage. (Laurie Campbell)

3.4 Reptiles and Amphibians (medium importance)

No amphibians are strongly associated with waterfalls, but the barrier that high falls present to the upstream movement of fish reduces predation on Common Toads *Bufo bufo*, Common Frogs *Rana temporaria* and Palmate Newts *Lissotriton helvetica*, enabling them to breed in parts of the river system which otherwise may not be suitable.

3.5 Fungi and Lichens (medium importance)

Although not confined to waterfalls, a number of lichens occur on damp rocks in the **splash zone** including *Collema flaccidum.* The spores of some fungi are abundantly found in river foam, and a few species are known only from this source.

3.6 Birds (low importance)

Waterfalls often feature in the breeding territories of both Dippers *Cinclus cinclus* and Grey Wagtails *Motacilla cinerea,* and the nest may actually be located behind the falls. However, neither species are dependent on waterfalls.

3.7 Fishes (low importance)

Waterfalls usually present a barrier in the movement of fish. Some species, such as Salmon *Salmo salar* are able to leap low falls and Eels *Anguilla anguilla* may be able to go round them overland in certain conditions, but most species are constrained by them.

4. Environmental, Economic & Social Importance of Biodiversity

Waterfalls are significant features in the landscape, and the larger ones usually have individual names. Several are tourist attractions.

5. Factors affecting the Habitat

- **Pollution** of watercourses has the potential to adversely affect waterfall wildlife.
- **Pressure for removal of natural waterfalls** to allow fish access to a greater part of the river has come from some anglers.
- **Inappropriate abstraction** may reduce waterfall flow.
- There is the potential for disturbance from recreational disturbance.

EXPOSED RIVER SHINGLE

Priority Action (ERS1)

Identify areas of exposed river shingle with important invertebrate interest.
Target: Assess of 20 potential sites by 2015.
Lead Partner: Scottish Natural Heritage/Scottish Environment Protection Agency.

1. Habitat Description

1.1 Physical Characteristics

Exposed river shingle takes the form of banks, bars and islands. These features are generally transient, dependent on the natural processes of erosion, sediment transport and deposition. In the upper reaches of rivers narrow steep-sided channels prevent the formation of shingle features, but in more open channels, such as in U-shaped valleys, extremely **unstable shingle** banks often form, composed of small boulders and pebbles. In the lower reaches more **stable shingle**, composed of finer gravels, sometimes mixed with areas of sand and silt, is closely associated with rivers meandering across flood plains.

Upland shingle on Firthhope Burn, Carrifran. July 2006. (Peter Norman)

1.2 National and International Context

Exposed river shingle is widespread throughout Europe. It is most common in Britain in the north and west where the bedrock is hard, although there are significant lowland river shingles associated with younger rocks that are resistant to weathering, or glacial deposits. Studies indicate significant losses of exposed shingle habitat on several river systems in the UK.

2. Dumfries & Galloway Status

2.1 Recent Trends

Despite an increasing awareness of the biodiversity importance of exposed river shingle, these habitats remain at risk of removal through engineering works.

2.2 Current Distribution

Exposed river shingle occurs on all the main rivers in Dumfries & Galloway.

2.3 Site Examples

On the River Nith there are important areas of exposed river shingle at **Carnsalloch Shingle Bank** (LWS) and **Auldgirth**. Perhaps the best site in the region for invertebrates is the extensive shingle at **Ae Bridgend** on the Water of Ae. On headwaters, the **Moffat Water** has extensive areas of shingle.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with exposed river shingle, and the following action plans may also contain relevant information: River Headwaters, Lowland Rivers and Backwaters.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

A number of scarce and rare invertebrates are associated with exposed river shingle. There are recent (1990s) records from the Nith of *Perileptus areolatus,* a scarce ground beetle exclusively associated with exposed riverine shingle or sand, mostly near to the water's edge; a water beetle *Bidessus minutissimus* found in fine silt on a shingle bank near Dumfries; and Northern Stiletto-fly *Spiriverpa lunulata* on exposed sandy riverine sediments in the upper Cree/Minnoch.

There are old records from southern Scotland of other rare invertebrates associated with this habitat, and it is likely that new surveys would find some of these in Dumfries & Galloway. They include the nationally scarce ground beetles *Perileptus areolatus*, *Thalassophilus longicornis*, *Bembidion bipunctatum, B. litorale*, *B. testaceum* and *B. monticola* and a click beetle *Negastrius sabulicola*. A tiny and probably much overlooked rove beetle *Meotica anglica* is associated with riparian gravel and sand, but appears to be largely subterranean and rarely seen on the surface. It is currently known only from four sites in the world, all in the UK, including one in southern Scotland close to the Dumfriesshire border. It may therefore also be present in the region.

Though common in many habitats in Europe, in Britain the Five-spot Ladybird *Coccinella 5-punctata* is rarely found more than a few metres from unstable river shingle. Here, it is very rare and endangered, being rediscovered in 1987 following an absence of around 30 years. There are no records from Dumfries & Galloway, but one from near Carlisle suggests that its occurrence is not totally out of the question.

3.2 Birds (high importance)

Relatively few birds use exposed river shingle, but some species more typically found on the coast regularly nest on river shingle. These include Oystercatchers *Haematopus ostralegus* and Ringed Plovers *Charadrius hiaticula*. Little Ringed Plovers *Charadrius dubius* have also nested on river shingle at a few locations in Dumfries & Galloway, virtually their only Scottish breeding sites. Common Sandpipers *Actitis hypoleucos,* Grey Wagtails *Motacilla cinerea* and Pied Wagtails *Motacilla alba* regularly feed on river shingle.

3.3 Non-flowering Plants (medium importance)

Common mosses, such as River Feather-moss *Brachythecium rivulare* and Fountain Apple-moss *Philonotis fontana,* are the prime colonisers of upland **unstable shingle**. As the shingle becomes more stable they are replaced by flowering plants.

3.4 Fishes (medium importance)

The removal of exposed shingle denudes the river of substrates that are an essential part of the river system. This removes the possibility of such substrates forming important fish spawning habitats in other parts of the river.

Field Pansy on Water of Ae shingle. May 2008. (Peter Norman)

3.5 Flowering Plants (low importance)

Unstable shingle may support no flowering plants at all. Any that are able to colonise need to be fast growing prostrate plants that can withstand both drought and flood conditions. On more **stable shingle** the main colonisers are mainly opportunistic 'weed' species.

4. Environmental, Economic & Social Importance of Biodiversity

- River shingle forms an important habitat for several fish that are of economic importance.
- Shingle is one of several riverine features that add variety to watercourses, contributing to their visual appeal in the landscape.

5. Factors affecting the Habitat

- **River engineering**, such as straightening, dredging, or grading of river banks is likely to remove this habitat totally unless special care is taken.
- **Extraction of gravel** results in local destruction of the habitat. Even if adjacent areas of shingle are not removed, they may be loosened and become more susceptible to being washed away.

- **Livestock encroachment** on riverside shingle and other river bank features.
- **Agricultural pollution** (especially the use of pyrethroid sheep dips), nutrient enrichment, and acidification.
- Water level regulation and control of flow by **damming and flood alleviation** schemes.
- Colonisation of river banks by Himalayan balsam *Impatiens glandulifera* and other **invasive plant species**.

6. Strategic Actions

6.1 Recent and current activity

- **SNH** funded a survey of exposed river sediments in the Nith catchment in 1996 and 1997. The aim was to survey the habitat resource and to characterise the sediment types favoured by the specialist invertebrate fauna.
- Entomologists from the **Scottish Entomologists Meeting** in 2005 carried out brief surveys of a selected number of sites, and discovered a number of important invertebrates.

6.2 Other recommended actions

- **Consider designating as Local Wildlife Sites** those sites supporting viable populations of important invertebrates, where this is necessary to secure their long-term protection and appropriate management.
- **Advise landowners, managers and advisors** of the presence of this habitat and the importance of beneficial management for their conservation.
- Carry out comprehensive **invertebrate surveys** of potentially important sites.
- **Raise awareness** of the importance of exposed riverine sediment species and of the conservation issues associated with them. This may be achieved by articles in wildlife, environmental, and user-group (e.g. anglers, engineers) journals.

Partially vegetated river shingle on the Water of Ae. May 2008. (Peter Norman)

EUTROPHIC LOCHS

Priority Action (EL1)

Maintain good ecological status of eutrophic lochs by implementing measures included in River Basin Management Plan as part of EU Water Framework Directive.
Lead Partner: Scottish Environment Protection Agency.

Carlingwark Loch with fringing reedswamp. June 2008. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Eutrophic lochs have naturally high nutrient level, which makes them very productive. They have been classified as having more than 30 milligrams of calcium carbonate per litre, and a pH of more than 7. Anaerobic mud rich in organic matter supports abundant invertebrates, and dense populations of algae in mid summer often makes the water green. Their beds are covered by dark mud, rich in organic matter.

1.2 National and International Context

Eutrophic waters are most typical of hard water areas of southern and eastern Britain, but they also occur in the north and west, especially near the coast. Their total extent is not accurately known, the best estimate being around 1785km^2 in the UK with around 240km^2 in Scotland (around 15% of all Scottish standing waters).

2. Dumfries & Galloway Status

2.1 Recent Trends

Intensive agriculture in the catchments of lochs continues to increase levels of eutrophication and several lochs are now suffering from hyper-eutrophication, leading to algal blooms and fish/ invertebrate deaths.

2.2 Current Distribution

Eutrophic lochs are concentrated in the lowlands in the south of Dumfries & Galloway.

2.3 Site Examples

There are many eutrophic lochs in the region. Some of the best known are **Castle Loch** (SPA/SSSI), **Carlingwark Loch** (SSSI) and **Soulseat Loch.**

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with eutrophic lochs, and the following action plans may also contain relevant information: Swamps, Reedbeds, Fens, Marshes, Native Wet Woods, Mesotrophic Lochs, Reservoirs.

3. Importance for Associated Species

3.1 Birds (high importance)

Typical breeding waterfowl of eutrophic lochs include Great Crested Grebes *Podiceps cristatus,* Little Grebes *Tachybaptus ruficollis*, Mallards *Anser platyrhynchos*, Coots *Fulica atra* and Moorhens *Gallinula chloropus*. Rarer breeding species include Gadwalls *Anas strepera,* Garganeys *Anas*

Coots are common nesting birds on eutrophic lochs. (Gordon McCall)

querquedula, Pintails *Anas acuta,* Shovelers *Anas clypeata* and Tufted Ducks *Aythya fuligula,* whilst the very rare Black-necked Grebe *Podiceps nigricollis* has attempted to breed recently. In winter, wildfowl numbers are swelled by large numbers of Teals *Anas crecca,* Wigeons *Anas penelope,* Pochards *Aythya farina,* Goldeneyes *Bucephala clangula* and Coots.

Although grassland feeders, a number of wintering geese and swans use eutrophic lochs for roosting. Most important are Whooper Swans *Cygnus cygnus,* Pink-footed Geese *Anser brachyrhynchus,* Greylag Geese *Anser anser* and White-fronted Geese *Anser albifrons.*

3.2 Mammals (high importance)

The dense emergent and marginal vegetation of eutrophic lochs provide ideal habitat for Otters *Lutra lutra.* An abundance of insect life also makes these lochs valuable for all species of bat, with Daubenton's Bats *Myotis daubentonii* being specialist feeders over water.

3.3 Invertebrates (high importance)

Zooplankton is abundant in the water column of eutrophic lochs, and there may be abundant bottom-dwelling invertebrates. Many lochs have a diverse invertebrate fauna, including snails, crustaceans, water beetles and dragonflies. Blue-tailed damselflies *Ishnura elgans* and Common Blue damselflies *Enallagma cyathigerum* can be abundant. Duck Mussels *Anodonta anatina* are known in the region only from Castle Loch (Lochmaben).

3.4 Fishes (medium importance)

Eutrophic lochs are important for their high populations of coarse fish, including Pike *Esox lucius,* Roach *Rutilus rutilus* and Tench *Tinca tinca*, which is uncommon in Scotland.

3.5 Flowering Plants (medium importance)

Pondweed communities of eutrophic lochs include less common species such as Flat-stalked Pondweed *Potamogeton friesii*, Lesser Pondweed *P. pusillus*, Blunt-leaved Pondweed *P. obtusifolius* and Fennel Pondweed *P. pectinatus*, all recorded from Carlingwark Loch. There is often a marginal fringe of reedswamp that can include scarce species such as Cowbane *Cicuta virosa,* Sawwort *Serratula tinctoria* and Lesser Tussock-sedge *Carex diandra*.

3.6 Non-flowering Plants (medium importance)

Planktonic algae are usually abundant in the water column, where they are responsible for production of most of the nutrients that support other biodiversity. The rare aquatic fern Pillwort *Pilularia globulifera* grows in eutrophic lochs where competition is reduced by fluctuating water levels or disturbance, such as in Loch Ken. It is however, susceptible to over-eutrophication.

3.7 Reptiles and Amphibians (low importance)

Most eutrophic lochs contain too many predators to be suitable for breeding amphibians, though some may be able to find suitable sites on quiet lochsides. Common Toads *Bufo bufo* are more able to withstand predation than other amphibians.

4. Environmental, Economic & Social Importance of Biodiversity

- Many eutrophic lochs are located close to towns and villages and are significant landscape and recreational assets for these communities.

5. Factors affecting the Habitat

- **Nutrient enrichment** caused by organic and inorganic fertilisers damages plant and animal communities and results in a loss of biodiversity.
- **Algal blooms and excessive weed growth** are a problem in many lochs, compounded by high nutrient inputs through diffuse pollution.
- Changes in land-cover can result in increased siltation and release of nutrients into the water body, causing increased eutrophication. **Removal of waterside vegetation** and reedswamp is damaging, as they act as barriers to particulate matter and absorb nutrients.
- The **introduction of fish or removal of predators** leads to the loss of natural fish populations and may affect plant and invertebrate communities. Heavy stocking of bottom-feeding fish such as Carp *Cyprinus carpio* can cause turbidity and accelerate the release of nutrients from sediments.

- **Recreational and sporting use** may create disturbance. Marginal vegetation may suffer from trampling and wave erosion; the action of boat hulls and propellers destroys aquatic plants and stirs up sediments, contributing to enrichment. The construction of marinas and other leisure facilities may also destroy valuable habitat and can lead to increased pollution. However, recreational use can often be sustained with minimal damage to biodiversity, through adequate management programmes

6. Strategic Actions

6.1 Recent and current activity

- The **EU Water Framework Directive** requires preparation and implementation of River Basin Management Plans. These will include a series of measures to maintain good ecological status of all waterbodies.
- Loch Ken, Castle Loch and Carlingwark Loch have **management plans and advisory management committees.**
- Nutrient levels are monitored by **SEPA** at some lochs, such as Castle Loch and Carlingwark Loch.
- **Dumfries & Galloway Council** carry out control of algal blooms in Carlingwark Loch by the annual installation of specially designed straw booms that chemically counteract the algae.

Flood debris supports a varied, if inconspicuous, biodiversity. Woodhall Loch, March 2007. (Peter Norman)

6.2 Other recommended actions

- Conduct **research** to determine the level of agricultural run-off reaching lochs and the impact in terms of eutrophication.
- Investigate the causes of **algal blooms** and possible solutions.

MESOTROPHIC LOCHS

Priority Action (EL1)

Maintain good ecological status of mesotrophic lochs by implementing measures included in River Basin Management Plan as part of EU Water Framework Directive.
Lead Partner: Scottish Environment Protection Agency.

Loch Kindar, April 2007. (Richard Mearns)

1. Habitat Description

1.1 Physical Characteristics

Mesotrophic lochs are characterised by having a narrow range of nutrients, particularly organic nitrogen and total phosphorous. They have been classified as having 10-30 milligrams of calcium carbonate per litre, and a pH of around 7. They also usually have a hard substratum, often clear water, but plenty of submerged and emergent plants.

1.2 National and International Context

Mesotrophic lakes and lochs are largely confined to the margins of upland areas in the north and west of Britain. Bassenthwaite and Derwentwater in the Lake District are two of the best examples in England. Due to their sensitivity to artificially increased levels of nitrogen and phosphorous, they are an increasingly rare type of waterbody, but there is an estimated 1,750 mesotrophic standing waters in Scotland.

2. Dumfries & Galloway Status

2.1 Recent Trends

Intensive agriculture in the catchments of lochs continues to increase levels of eutrophication. Mesotrophic lochs are an increasingly rare and threatened habitat.

2.2 Current Distribution

There is no comprehensive inventory of mesotrophic lochs in the region.

2.3 Site Examples

A number of lochs have been assessed from vegetation surveys and chemical samples as being mesotrophic. They include **Milton Loch** (SSSI) and **Loch Kindar** (LWS). **Mill Loch** (SSSI) at Lochmaben was formerly mesotrophic but now appears to be eutrophic.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with mesotrophic lochs, and the following action plans may also contain relevant information: Swamps, Reedbeds, Fens, Marshes, Native Wet Woods, Eutrophic Lochs, Reservoirs.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Mesotrophic lochs potentially have the highest diversity of large plants and contain a higher proportion of nationally scarce and rare aquatic plants than any other loch type. Typical species include Yellow Water-lily *Nuphar lutea* and Amphibious Bistort *Persicaria amphibia.* Slender Naiad *Najas flexilis* is a rare aquatic plant usually found in deep, clear, mesotrophic lochs. It occurs predominantly in western Ireland and the Scottish Highlands and Islands, but has been recorded from Loch Kindar.

3.2 Birds (very high importance)

Mesotrophic lochs support the greatest number and diversity of waterbirds of any waterbody type. Typical breeding species include Great Crested Grebes *Podiceps cristatus* Mallards *Anser platyrhynchos* and Tufted Ducks *Aythya fuligula.* Less common nesting wildfowl include Gadwalls *Anas strepera,* Pintails *Anas acuta,* Shovelers *Anas clypeata,* and Teals *Anas crecca.*

In winter, mesotrophic lochs may be used by large numbers of feeding and roosting Whooper Swans *Cygnus cygnus,* Pink-footed Geese *Anser brachyrhynchus,* Greylag Geese *Anser anser,* White-fronted Geese *Anser albifrons,* Pochards *Aythya farina* and Goldeneyes *Bucephala clangula.*

3.3 Fishes (very high importance)

The mesotrophic Mill Loch at Lochmaben once supported Vendace *Coregonus albula* at one of its few British sites. This species now appears to have become extinct due to eutrophication, but has been introduced to Loch Skene, an oligotrophic loch in the Moffat Hills. A wide range of coarse and salmonid fish is also found in mesotrophic lochs.

Four-spotted Chaser dragonfly, Lochmaben 2008. (Paul McLaughlin)

3.4 Invertebrates (very high importance)

Mesotrophic lochs are among the richest of all caddisfly habitats. Other macroinvertebrates are well represented, with particularly important groups being dragonflies, water beetles, stoneflies and mayflies. Aquatic marginal and terrestrial transition zones can be rich in terrestrial groups such as flies and beetles. Hairy Dragonflies *Brachytron pratense* are typical of well-vegetated mesotrophic lochs in England, but are restricted to a few sites in Scotland, including Colvend Lochs in Dumfries & Galloway.

3.5 Mammals (high importance)

Emergent and marginal vegetation of mesotrophic lochs provide ideal habitat for Otters *Lutra lutra.* An abundance of insect life also makes these lochs valuable for all species of bat, with Daubenton's Bats *Myotis daubentonii* being specialist feeders over water.

3.6 Non-flowering Plants (medium importance)

Planktonic algae are usually abundant in the water column, where they are responsible for production of most of the nutrients that support other biodiversity. Stoneworts are more complex types of algae, often pioneers on the open beds of newly created water bodies, forming dense underwater meadows. They are not confined to mesotrophic lochs, but are often swamped by the vigorous growth of flowering plants in more nutrient-rich waterbodies. Just a few stoneworts have been recorded in Dumfries & Galloway, including Translucent Stonewort *Nitella translucens* in Morton Loch.

3.7 Reptiles and Amphibians (low importance)

Most mesotrophic lochs contain too many predators to be suitable for breeding amphibians, though some may be able to find suitable sites on quiet lochsides. Common Toads *Bufo bufo* are more able to withstand predation than other amphibians.

4. Environmental, Economic & Social Importance of Biodiversity

Mesotrophic lochs are significant landscape and recreational assets for local communities and visitors.

5. Factors affecting the Habitat

- **Nutrient enrichment** (eutrophication) has a major impact on mesotrophic lochs, causing increased growth of aquatic algae and larger plants. If eutrophication reaches a threshold, the submerged aquatic flora will deteriorate and may disappear. Many aquatic invertebrates are very sensitive to pollution. Pollution may have many sources, including discharge of sewage effluent, forestry and agricultural run-off, and accidental spillages of, for example, slurry. Airborne water acidification is also a factor in some upland catchments.
- Activities such as **ploughing, afforestation and peat cutting** can increase soil erosion with a consequent increase in water-borne sediments. In suspension, these cause turbidity and reduction in light levels, inhibiting the growth of rooted aquatic plants and increasing the likelihood of algal blooms. Settled sediments may continue to introduce nutrients into the water column and may change the lake bed substrate.
- **Introduced fish** for angling can have an adverse effect on loch ecosystems by eating the invertebrates that graze algae and keep it in check. The introduction of bottom-feeding fish such as carp will disturb the sediments, leading to turbidity and the release of nutrients, which will encourage algal blooms. If not properly managed, angling can also result in disturbance of wildlife, including nesting birds.
- Water-borne **recreation traffic** can damage aquatic plants at the point of launch, or through bankside wave erosion, passage through strands of vegetation, or the cutting action of propellers. Increased turbidity from boat-wash may also compound plant loss. This again may promote unwanted algal growth.

6. Strategic Actions

6.1 Recent and current activity

- The **EU Water Framework Directive** requires preparation and implementation of River Basin Management Plans. These will include a series of measures to maintain good ecological status of all waterbodies.
- **SEPA** has prepared a provisional inventory of Scottish mesotrophic lochs, based on existing survey information. The inventory is not likely to be comprehensive.

6.2 Other recommended actions

- Carry out a survey to **identify current mesotrophic lochs** in Dumfries & Galloway, and those that were naturally mesotrophic but which have been changed as the result of man's activities.
- **Control discharges** of effluent from wastewater treatment works and other point sources of pollution to ensure that the quality and quantity of they do not pose a threat to mesotrophic lochs.
- **Investigate the causes of algal blooms** in mesotrophic lochs of Dumfries & Galloway.

OLIGOTROPHIC LOCHS

Priority Action (EL1)

Maintain good ecological status of oligotrophic lochs by implementing measures included in River Basin Management Plan as part of EU Water Framework Directive.
Lead Partner: Scottish Environment Protection Agency.

Loch Dee with Water Lobelia in the foreground. July 2007. (Richard Mearns)

1. Habitat Description

1.1 Physical Characteristics

Oligotrophic, or nutrient poor, lochs typically occur in acidic upland areas and are characterised by cold, well oxygenated clear waters with only a small aquatic plant and invertebrate community. They have been classified as having 0-10 milligrams of calcium carbonate per litre, and a pH of 6-7.

Dystrophic lochs are the most extreme of nutrient poor waterbodies, highly acidic and confined to peaty areas. They have been classified as having 0-2 milligrams of calcium carbonate per litre, and a pH of less than 6.

1.2 National and International Context

Oligotrophic waters are widespread throughout Europe. They are also widespread in Britain, but frequent only in the uplands of the north and west.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little new afforestation in recent decades, and considerable improvements in forest management to reduce effects on upland lochs.

2.2 Current Distribution

Oligotrophic lochs are predominantly located in the Southern uplands in the north of the region.

2.3 Site Examples

The lochs of the Galloway Hills are mostly oligotrophic: **Loch Enoch** (SSSI), **Loch Neldricken** (SSSI), **Loch Valley** (SSSI), **Long Loch of Glenhead** (SSSI), **Round Loch of Glenhead** (SSSI), **Long Loch of The Dungeon** (SSSI), **Round Loch of The Dungeon** (SSSI), **Loch Grannoch, Loch Fleet, Loch Dee, Loch Skerrow, Stroan Loch** (SSSI) and **Lochenbreck Loch**. Away from this area, in Wigtownshire **Mochrum Lochs** (SSSI) includes several oligotrophic lochs and in Dumfriesshire **Loch Skene** (SSSI) is probably the most important site in the region, with relatively little human modification and supporting several rare species.

Dystrophic lochs are rare in Dumfries & Galloway, but **Dernaglar Loch** (SSSI) in Wigtownshire and **Ironhirst Loch** in Dumfriesshire may fall into this category. The latter site is entirely man-made through nineteenth and early 20th century peat extraction on Lochar Moss.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with oligotrophic lochs, and the following action plans may also contain relevant information: Blanket Bogs, Upland Heaths, Acid Grasslands, Conifer Plantations, Reservoirs.

3. Importance for Associated Species

3.1 Non-flowering Plants (high importance)

Quillwort *Isoetes lacustris* is a submerged aquatic perennial related to ferns, found in oligotrophic lochs with a rocky substrate. It is frequent in such habitats in Dumfries & Galloway, but otherwise mainly restricted to the Highlands, Lake District and Wales. Spring Quillwort *Isoetes echinospora* has a similar distribution but is less common throughout its range, despite occurring on a wider range of substrates.

Though poor in aquatic mosses and liverworts, oligotrophic lochs are reasonably rich in riparian bryophytes. Typical species of loch side boulders include Pendulous Wing-moss *Antitrichia curtipendula* and Spreading-leaved Grimmia *Grimmia curvata.*

3.2 Flowering Plants (high importance)

Though oligotrophic lochs do not support a great diversity of flowering plants, a number of species of high conservation value are found. These include: Awlwort *Subularia aquatica,* an annual aquatic that grows on silt, gravel or stony substrates in shallow water; Water Lobelia *Lobelia dortmanna,* a slow-growing attractive herb with little ability to withstand shade or competition; Intermediate Bladderwort *Utricularia intermedia*, a semi-carnivorous, rare-flowering species of shallow water; and Esthwaite Waterweed *Hydrilla verticillata* at its only extant UK site. More typical species include Alternate Water-milfoil *Myriophyllum alterniflorum* and Bog Pondweed *Potamogeton polygonifolius.*

3.3 Invertebrates (high importance)

The invertebrate fauna of oligotrophic lochs is dominated by mayflies and caddisflies in shore zones, though a few common species from the lowlands, such as a diving beetle *Hydroporus erythrocephalus,* are equally at home in such habitats. The only known world site of a pond snail *Lymnaea burnetti* is Loch Skene, although it is probably not a distinct species, but a form of very common *Lymnaea peregra* that has resulted from the harsh environment and genetic isolation.

Goldeneye, one of the few ducks to frequent oligotrophic lochs in winter. (Gordon McCall)

3.4 Birds (high importance)

The Black-throated Diver *Gavia arctica* is a nationally rare breeder and has attempted breeding on lochs in the Southern Uplands, the most southerly location in Britain. Common Scoter *Melanitta nigra* may also occasionally attempt to breed. More common, though still scarce, breeding wildfowl include Teals *Anas crecca* and Wigeons *Anas Penelope.* A number of scarce upland breeding waders, such as Dunlins *Calidris alpina* feed on the edges of oligotrophic lochs. In winter, these lochs support few birds with only Goldeneyes *Bucephala clangula* regularly recorded in small numbers.

3.5 Fishes (medium importance)

Brown Trout *Salmo trutta* are often the commonest fish species in oligotrophic lochs, though conditions rarely ideal for optimum growth. Arctic Charr *Salvelinus alpinus* are scarce in Britain, occurring mainly in the Scottish Highlands. In Dumfries & Galloway they used to be found in Loch Grannoch and Loch Dungeon, but now probably only occur just over the border of the region in Loch Doon. Vendace *Coregonus albula* have been introduced to Loch Skene and appear to be prospering.

3.6 Mammals (low importance)

Remote, undisturbed oligotrophic lochs appear to fulfil the public perception of ideal Otter *Lutra lutra* habitat. In reality the low productivity and lack of dense riparian vegetation mean that they are infrequently visited by Otters and other mammals.

3.7 Fungi and Lichens (low importance)

Oligotrophic lochs are generally the richest lochs for lichens, though the degree of shade and type of rock has an important bearing on species composition.

An aquatic lichen Porpidia hydrophila on submerged rocks in Loch Trool. March 2007. (Peter Norman)

3.8 Reptiles and Amphibians (low importance)

In some circumstances Common Frogs *Rana temporaria,* Common Toads *Bufo bufo* and Palmate Newts *Lissotriton helvetica* may be found in oligotrophic lochs, but the habitat is generally poor for amphibians.

4. Environmental, Economic & Social Importance of Biodiversity

Often located in remote areas, oligotrophic lochs are an important component of wild-land environments.

5. Factors affecting the Habitat

- **Acidification** as a result of atmospheric deposition of pollution, exacerbated by local geology, soils and land use, especially forestry. Despite recent improvements in forest design and management, acidification remains an issue.
- **Eutrophication** caused primarily by nitrates or phosphates in run-off from surrounding agricultural or forestry operations, though most land surrounding oligotrophic lochs in Dumfries & Galloway is not subject to intensive management.

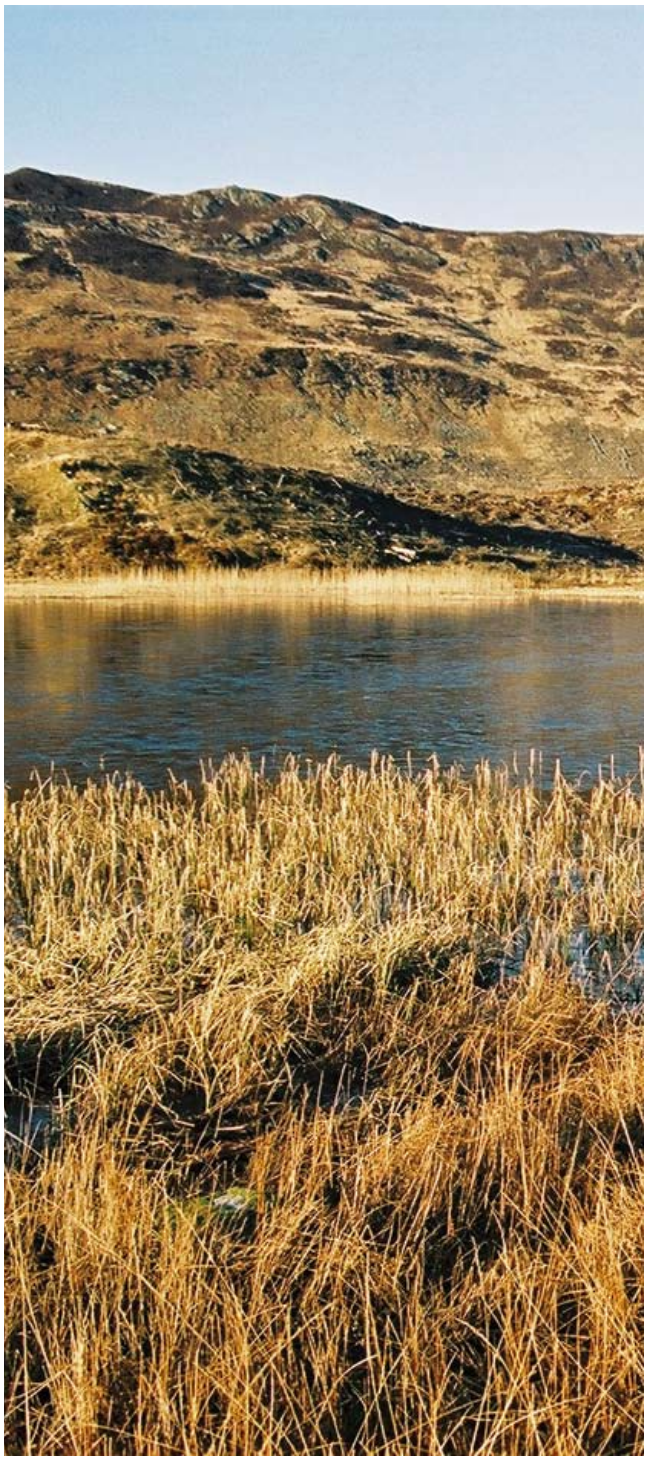
6. Strategic Actions

6.1 Recent and current activity

- The **EU Water Framework Directive** requires preparation and implementation of River Basin Management Plans. These will include a series of measures to maintain good ecological status of all waterbodies.
- The **Loch Dee Project** and subsequent research has looked into the causes and possible solutions of acidification.
- **SEPA** monitor freshwater acidification at several sites.
- Fish populations are monitored by **Galloway Fisheries Trust.**
- **Forestry Commission Scotland** has made changes to the structure of forests in line with agreed Forest and Water Guidelines.

6.2 Other recommended actions

- Continue research and action to reduce the impacts of acidification of oligotrophic lochs.
- Consider **reintroduction of Arctic Charr** to Loch Grannoch, if conditions are considered suitable.



A completely frozen Lillie's Loch, near Clatteringshaws. January 2003. (Peter Norman)

SWAMPS

Priority Action (S1)
Continue with current management.

Fringing swamp at Hightae Mill Loch, Lochmaben 2008. (Paul McLaughlin)

1. Habitat Description

1.1 Physical Characteristics

Swamps are vegetated habitats where the water table is above the ground level for much, if not all, of the year. They usually have tall vegetation dominated by one or two species. Fen and swamp habitats often occur together and may integrate, but can also be found separately. Both often grade into open water at one end and carr at the other and some times occur in association with reedbeds.

1.2 National and International Context

Swamps are widespread across Europe, though probably have declined in the last 50 years. Due to the fact that this habitat usually occurs in close association with other wetland types, it is not possible to make an accurate assessment of the extent of swamps in Scotland, but in 1998 there was approximately 3370km^2 of fen, marsh and swamp (the majority likely to be marsh). The extent in Dumfries & Galloway is not known.

2. Dumfries & Galloway Status

2.1 Recent Trends

In Scotland, there has been an increase in swamps since the 1990s, but the trend in Dumfries & Galloway is not known.

2.2 Current Distribution

In Dumfries & Galloway swamp is widespread but fragmented. It is usually integrated with fens, carrs, reedbeds and open water habitats.

2.3 Site Examples

A large number of small sites are present across the region, but larger areas of this habitat is found on a number of designated sites, including **Ken-Dee Marshes** (SPA/SSSI), **Kenmure Holms** (SPA/SSSI), **Blackpark Marsh**, Threave (SPA/SSSI), **Carlingwark Loch** (SSSI), **Auchrochar Wetlands** (SSSI), **Dowalton Loch** (SSSI), **Hightae Mill Loch** (LNR), **Cumrue Loch** (LWS) and **Colvend Lochs** (LWS).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with swamps, and the following action plans may also contain relevant information: Eutrophic Lochs, Mesotrophic Lochs, Oligotrophic Lochs, Reedbeds, Fens, Native Wet Woods.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Bogbean, Lochmaben, May 2007. (Paul McLaughlin)

Swamps have species poor vegetation in comparison to fens, often dominated by beds of Bottle Sedges *Carex rostrata* or Bladder Sedges *C. vesicaria*. However, less common plants occur, including Cowbane *Cicuta virosa*, Greater Spearwort *Ranunculus lingua*, Water Sedge *Carex aquatilis* and Great Fen Sedge *Cladium mariscus*.

3.2 Birds (medium importance)

A number of birds nest and feed within swamps, and swamp vegetation may be particularly important in providing cover for their young. Species include Little Grebes *Tachybaptus ruficollis,* Water Rails *Rallus aquaticus,* Shovelers *Anas clypeata*, Teals *Anas crecca*, and Pintails *Anas acuta.* During the autumn and winter, swamps form an important roosting habitat for harriers.

3.3 Invertebrates (medium importance)

Swamps are an important habitat for several species of snail, including the nationally rare Lilljeborg's Whorl Snail *Vertigo lilljeborgi,* which is restricted to decaying vegetation in sedge and rush swamps, sometimes shaded by Alders. It has recently been recorded at a few sites in Wigtownshire, but may have been lost form Kirkcudbrightshire and Dumfriesshire.

3.4 Reptiles and Amphibians (low importance)

Amphibians such as Common Frogs *Rana temporaria* are found in swamps

Common Frog, Lochmaben, March 2007. (Paul McLaughlin)

3.5 Mammals (low importance)

A number of mammals hunt for food in swamps, though a mosaic of wetland habitats is probably more important to them than swamps alone. Typical species include Otters *Lutra lutra,* Water Shrews *Neomys fodiens* and all species of bats.

3.6 Non-flowering Plants (low importance)

A number of bryophytes are adapted to the semi-aquatic conditions of swamps, including the Lesser Cow-horn Bog-moss *Sphagnum inundatum.*

3.7 Fishes (low importance)

Though a number of fish species can be found in swamps, the habitat is not of critical importance to them.

4. Environmental, Economic & Social Importance of Biodiversity

Swamps provide protection from bankside erosion in lochs and rivers.

5. Factors affecting the Habitat

- Dumfries & Galloway's swamps are mostly **small in extent and highly fragmented**.
- As with other wetland habitats, swamps are dependent on good water quality and can be damaged by **pollution and excessive nutrient inputs** from surrounding land-uses leading to eutrophication.
- Though drainage of swamps is rarely successful, **changing water levels** in adjacent rivers and lochs will lead to the loss or displacement of swamps.

Water Horsetail swamp. Carrick Ponds, June 2007. (Peter Norman)

- Grazing with cattle can maintain plant diversity, but there is an increasing **reluctance to graze** stock in such habitats. Ungrazed swamps can quickly become dominated by a single species, such as Reed Sweet Grass.
- **Invasive plants** such as American Skunk Cabbage may pose a threat in some locations.

6. Strategic Actions

6.1 Recent and current activity

- In other parts of the UK, loss of cattle grazing has been replaced by **grazing with water buffalo.**

6.2 Other recommended actions

- Identify the **current extent and distribution** of swamps in Dumfries & Galloway.

REEDBEDS

Priority Action (RB1)

Create new reedbeds in Dumfries and Galloway.
Target: 20ha of new reedbed by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Habitat Description

1.1 Physical Characteristics

Reedbeds are dominated by stands of one plant, the Common Reed. Most are freshwater habitats, but reedbeds are also found in brackish and tidal waters. Where they have 20cm or more of surface water in the summer they are often referred to as reedswamps. Reedbeds with water at or below the surface are often referred to as reedfens. In practice there is no clear distinction between the two, and Common Reed may be a component of many types of swamp, fen and other wetland habitats.

Common Reed is an active coloniser of wet ground or open water and reedbeds form a transition stage in the eventual succession to woodland. In tidal areas or sites that are subject to regular freshwater flooding, a reedbed may persist in a relatively stable state unless there is heavy siltation. Elsewhere, the accumulation of dead vegetation and **reed litter** will result in the gradual drying of the bed, allowing growth of scrub or woodland species.

1.2 National and International Context

British reedbeds are geographically important in a global context, being some of the farthest west in Europe. In 1994 there were approximately 1000 reedbed sites in the UK totalling around 6,530ha, mostly in small blocks of less than 1ha, making it a nationally scarce habitat. There are probably less than 100ha of reedbeds in Dumfries & Galloway.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little deliberate drainage or removal of reedbeds in recent years, but the natural succession of reedbeds to scrub and drier habitats is likely to have resulted in their continual decline. Since the late 1990s, interest in reedbeds from a conservation and water treatment perspective has grown, but this has not so far resulted in the creation of any extensive new reedbeds.

Reedbeds fringe many lochs and ponds. Collochan Loch, Terregles, April 2006. (Peter Norman)

2.2 Current Distribution

Reedbeds in Dumfries & Galloway are widely scattered but highly fragmented. Most of the estuaries have some reedbeds; there many small reedbeds scattered throughout lowland farmland and on slow flowing stretches of some rivers. However, reedbeds are perhaps most frequent as a narrow fringe around many lowland lochs.

2.3 Site Examples

Some of the larger brackish reedbeds are found around the edge of **Wigtown Bay**, at the confluence of Rivers Tarff and Dee in the upper reaches of **Kirkcudbright Bay** and in the **Nith Estuary.** Narrow freshwater reedbeds fringe many lochs in the region, with more extensive areas at a few sites, such as at **Glentoo Loch** and **Lochrutton Loch** (LWS).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with reedbeds, and the following action plans may also contain relevant information: Coastal Saltmarshes (Merse), Lowland Burns and Ditches, Fens, Swamps, Marshes.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

All stages in the development of reedbeds are important habitats for invertebrates; the areas of lowest invertebrate interest being those of open water.

Forty species of bugs, moths, beetles and flies are known to feed only on reed, with a further 24 insects feeding partly on reed during their life cycle. A wide range of invertebrates is also associated with reed even if they do not feed directly on it. These include predators (mainly beetles and spiders) and parasites of the reed-feeding invertebrates which live in the stems, including gall-forming flies and solitary wasps.

3.2 Birds (high importance)

The Reed Warbler *Acrocephalus scirpaceus* is a reedbed specialist, rarely nesting in other habitats. Although common in England, it was not known in Scotland until breeding was recorded in Dumfries & Galloway in the 1990s. It continues to expand its range. Water Rails *Rallus aquaticus,* Sedge Warblers *Acrocephalus schoenobaenus* and Reed Buntings *Emberiza schoeniclus* also breed in reedbeds, though are less dependent on this habitat. Marsh Harriers *Circus aeruginosus* are occasional breeders in Dumfries & Galloway, favouring reedbeds for nesting, but also using other habitats. Bitterns also probably once bred in Dumfries & Galloway and are still occasionally recorded as visitors. They require large reedbeds, but if such conditions could be created it is highly likely that they would return as a breeding species.

Reedbeds provide roosting sites for a few of other species, particularly Swallows *Hirundo rustica*, House Martins *Delichon urbica* and Starlings *Sturnus vulgaris*, and occasionally Hen Harriers *Circus cyaneus.* Wintering wildfowl also use them.

3.3 Mammals (high importance)

Although by no means confined to this habitat, it has been suggested that Water Voles *Arvicola terrestris* that inhabit extensive reedbeds are better able to withstand predation by Mink *Mustela vison*. Water Shrews *Neomys fodiens* and Harvest Mice *Micromys minutus* also breed in reedbeds, the latter at its northern limit in Britain. Otters *Lutra lutra* frequently lie-up in the dense cover of reedbeds during the day, and hunt for Eels and other fish during the night.

3.4 Fishes (medium importance)

The fish species of reedbeds are similar to those of lowland rivers. They include Pike *Esox lucius* and Eels *Anguilla anguilla* in ditches and Minnows *Phoxinus phoxinus* and Three-spined Sticklebacks *Gasterosteus aculeatus* amongst the reedstems of flooded reedbeds.

3.5 Flowering Plants (low importance)

The wettest reedbeds may contain Common Reed *Phragmites australis* and little else, but most reedbeds include some other species, including Yellow Flag Iris *Iris pseudacorus* and Reedmace *Typha latifolia*. Less common associates include Cowbane *Cicuta virosa* and stands of Greater Tussock Sedge *Carex paniculata*.

4. Environmental, Economic & Social Importance of Biodiversity

Common Reed is known to be an efficient natural water purifier, and is increasingly being used specifically for this purpose in constructed reedbeds.

5. Factors affecting the Habitat

- Loss of reedbeds through **land drainage and conversion** to intensive agriculture.
- **Lack of management** leading to drying, scrub encroachment and succession to woodland
- **Pollution and siltation** of water sources feeding reedbed systems causing eutrophication and death of reed and associated organisms.

6. Strategic Actions

6.1 Recent and current activity

- Reedbeds have been constructed by **Scottish Water** for water treatment purposes at various locations (e.g. Beeswing treatment works).
- In 1997 **RSPB** began creating new reedbeds on land of low conservation interest at Mersehead.

6.2 Other recommended actions

- **Assess the current extend and distribution** of reedbeds in Dumfries & Galloway.
- **Increase the size** of reedbeds in Dumfries & Galloway. A few large reedbeds are preferable to many smaller ones.
- Encourage the continued use of reedbeds for **water treatment** purposes.

MARSHES

Priority Action (MA1)

Identify areas where new floodplain grazing marsh could be created that will contribute to biodiversity enhancement and flood alleviation, taking into account of current land-uses, landscapes and cultural heritage.
Target: Carry out a feasibility study by 2015.
Lead Partner: Dumfries & Galloway Flood Liaison and Advisory Group

1. Habitat Description

1.1 Physical Characteristics

Marsh is a rather ill defined term but usually refers to vegetation occurring on mineral soils that has the water table close to the surface for most of the year. They are usually found in lowland areas. Some have formed under relatively natural circumstances, for example around the margins of lochs and ponds, and many of these have existed at the same location for many years with little human modification. Many others occur on agricultural land with poor drainage.

Extensive marshes, along with swamp and wet woodland at Kenmure Holms, New Galloway, June 2007. (Peter Norman)

Though grazing takes place on many marshes, some have a long history of management that involves deliberate periodic flooding and livestock grazing. **Coastal grazing marshes** are periodically inundated pastures found behind the sea wall, whilst **floodplain grazing marshes** are areas of flat ground that are regularly flooded by adjacent watercourses. Both habitats usually contain **ditches**, which assist in maintaining high ground water levels and are sometimes used as stock barriers, and brackish or freshwater **pools** that can be seasonal or permanent. Seasonal flooding is an integral part of land management, so ditches tend to have high water levels throughout much of the year, and support a high biodiversity. Other management sometimes includes cutting for hay or silage.

1.2 National and International Context

There are an estimated total of 300,000ha of **grazing marsh** in the UK. 100,000ha of this are found in Scotland, Wales and Northern Ireland collectively. Only a small proportion of this figure is semi-natural, supporting a high diversity of native plant species (5,000ha in the UK, half of which is found outside England). Other types of marshes are more widespread and abundant - in 1998 there was approximately 3,370km^2 of fen, marsh and swamp in Scotland, the majority likely to be marsh.

2. Dumfries & Galloway Status

2.1 Recent Trends

In Scotland, there has been an increase in marshes since 1990s, but the trend in Dumfries & Galloway is not known. For **floodplain grazing marshes,** there have been no recent losses but the traditional management of this habitat continues to decline. Changes to flooding patterns, perhaps as a result of climate change, can make grazing and mowing difficult, leading to abandonment of these practices. A few new **coastal grazing marshes** have been created by conservation organisations.

2.2 Current Distribution

In Dumfries & Galloway marsh habitat is widespread but fragmented. Most **floodplain grazing marsh** in Dumfries & Galloway is found on the rivers Bladnoch, Dee, Ken, Nith and Annan, but it is estimated to be less than 500ha in area. **Coastal grazing marsh** is extremely limited extent and it is possible that there are no sites that have the full range of features found in areas such as Broadland or the Somerset Levels.

2.3 Site Examples

Extensive marshes are found around the fringes of **Loch Ken** (SPA/SSSI). There are excellent grazing marshes, as part of a mosaic of wetland habitats, between Torhouse Mill and Mochrum Park on the **Bladnoch floodplain** (LWS) and at **Threave** (SPA/SSSI) on the River Dee. Coastal grazing marsh has been recreated at **Caerlaverock**, **Mersehead**, and **Wigtown Harbour**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with marshes, and the following action plans may also contain relevant information: Lowland Burns and Ditches, Eutrophic Lochs, Mesotrophic Lochs, Fens, Swamps, Reedbeds, Neutral Grasslands, Native Wet Woods, Agriculturally Improved Grasslands, Urban Watercourses and Wetlands.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Often the dominant plants of marshes are rushes, but many other species are also found. Typical wildflowers include Meadowsweet *Filipendula ulmaria* and Ragged Robin *Lychnis flos-cuculi,* whilst Small Water Pepper *Persicaria minor*, an annual of wet marshy places trampled by stock, is mostly confined to the southwest in Scotland. Orchids include Northern Marsh *Dactylorhiza purpurella* and Early Marsh *Dactylorhiza incarnata.*

Globeflower, a local speciality of marshes and wet meadows, Dundrennan, June 2006. (Peter Norman)

Typical plants of **grazing marshes** include Cuckoo Flower *Cardamine pratensis*, Marsh Cinquefoil *Potentilla palustris* and various sedges and rushes including Carnation Sedge *Carex panacea* and tussocks of Soft Rush *Juncus effuses.* Less common species include Marsh Stitchwort *Stellaria palustris*. Purple Loosestrife *Lythrum salicaria* and Common Reed *Phragmites australis* are typical **ditch** species.

3.2 Birds (high importance)

Snipe *Gallinago gallinago,* Curlews *Numenius arquata* and Redshanks *Tringa totanus* are typical breeding birds of marshes in Dumfries & Galloway, though have declined in recent years. Lapwings *Vanellus vanellus* require less dense vegetation and are therefore more common on grazing marshes. Winter flooding attracts wildfowl, particularly Barnacle Geese *Branta leucopsis,* Greylag Geese *Anser anser* and Pink-footed Geese *Anser brachyrhynchus.* Smaller birds such as Grasshopper Warblers *Locustella naevia* also nest in this habitat, whilst Spotted Crakes *Porzana porzana* are very rare breeders in dense ungrazed marshes. Marshes may also be used by hunting birds of prey, including Hen Harriers *Circus cyaneus,* Marsh Harriers *Circus aeruginosus* and Barn Owls *Tyto alba*.

Snipe often nest in tussocky marshes. (Steven Round)

3.3 Invertebrates (high importance)

A wide range of invertebrates is associated with marshes, such as a ground beetle *Pterostichus minor*, a common marsh species recorded at various locations in the region. The Silver Hook *Deltote uncula,* a day-flying moth that is locally distributed in Scotland, frequents marshes and other wet habitats. The caterpillars of Small Pearl-bordered Fritillary *Boloria selene* feed on Marsh Violet, and this butterfly is possibly more common on fens and marshes than in other habitats in Dumfries & Galloway.

The caterpillars of Small Pearl-bordered Fritillary butterflies often feed on Marsh Violets. (Richard Mearns)

The greatest diversity of invertebrates on **coastal and floodplain grazing marshes** is usually found in the **ditches** or other permanently saturated ground. Dragonflies, ground beetles, water beetles and some groups of flies are of most importance, though few surveys have been completed in Dumfries &

Galloway. Non-biting midges *Chironomidae* are the most abundant group of insect. Larvae, pupae and adults form a critical part of the food chain for ducklings and many other birds. They depend on organic material in the damp surface layer of the soil.

3.4 Reptiles and Amphibians (medium importance)

No amphibians have a marked association with marshes, but all 6 species have been found in this habitat, including Natterjack Toads *Epidalea calamita.* Few reptiles are found, though there have been unconfirmed reports of Grass Snakes *Natrix natrix*.

3.5 Mammals (medium importance)

Otters *Lutra lutra*, Water Shrews *Neomys fodiens,* and Water Voles *Arvicola terrestris* all use marshes, though the latter tend to avoid sites with brackish water. Bats also take advantage of high invertebrate levels for feeding.

3.6 Non-flowering Plants (medium importance)

A range of mosses, liverworts and algae is found in grazing marshes.

3.7 Fungi and Lichens (low importance)

A range of grassland fungi occurs on marshes, especially those that have not been heavily improved. Some such as field mushrooms *Agaricus* spp. and mottlegills *Panaeolus* spp. are also able to withstand some fertilisation.

4. Environmental, Economic & Social Importance of Biodiversity

- Floodplain grazing marshes act as a natural form of flood alleviation, absorbing high river flows and reducing the speed that rainwater reaches watercourses. In doing so they also filter water, thereby improving water quality.
- Coastal grazing marshes give protection from coastal flooding and erosion.

5. Factors affecting the Habitat

- **Drainage** of land for agriculture has reduced the extent of marshes.
- Changes to flooding regimes and water levels has occurred as a result of engineering works such as **hydro-electric schemes and flood defences**, as well as climate change.
- Loss of traditional management regimes, including the **frequency and timing of grazing and cutting**, affects habitat composition.
- **Eutrophication** (nutrient loading) or other pollution of groundwater or surface water results in changes to plant diversity.
- Increased **salt water flooding** due to sea level rise threatens coastal sites.
- Floodplains, though part of a single ecological unit, are **rarely under single ownership** or management. It is therefore difficult to allow a more natural flood regime without affecting adjoining sites.

Northern Marsh Orchid. Carrick, Gatehouse of Fleet, June 2007. (Peter Norman)

6. Strategic Actions

6.1 Recent and current activity

Most coastal grazing marsh is managed for conservation by organisations such as the **Wildfowl and Wetlands Trust**, **RSPB** and **Dumfries & Galloway Council/Wigtown Bay Wildfowlers Club.**

6.2 Other recommended actions

- **Establish the location and extent** of marshes, especially coastal and floodplain grazing marshes, in Dumfries & Galloway.
- **Survey coastal and flood plain grazing marshes** in the region and use the data obtained to identify areas where restoration is possible and to act as a baseline for a monitoring programme.
- **Consider the feasibility of creating new areas** of marsh on land of low conservation and farm value, by raising water levels or allowing a watercourse to overflow onto its natural floodplain.
- Conduct **farm walks** on sites with marshes.

UPLAND SPRINGS & FLUSHES

Priority Action (USF1)

Monitor the quality of springs and flushes in the uplands of Dumfries & Galloway.
Target: Monitor springs and flushes at Carrifran until 2012.
Lead Partner: Borders Forest Trust

1. Habitat Description

1.1 Physical Characteristics

Upland springs are the source of many watercourses, where water bubbles or flows out of the ground, either strongly, or more usually as a slow seep. Flushes form where water, either from springs or other sources, flows diffusely over soil, gravel, stones or sparse vegetation.

Butterwort, a typical plant of unshaded flushes. Laghead, Gatehouse of Fleet, June 2007. (Peter Norman)

Despite the low volume of flow, spring-fed seepages are generally derived from very extensive underground aquifers, and are therefore not greatly affected by short-term fluctuations in rainfall. The water is usually cold, but temperature and acidity (pH) tends to be fairly constant throughout the year.

The mineral content of the water is determined by the chemical composition of the rocks from which it emerges. Where the rocks are alkaline or rich in lime, the plants that grow in the springs and flushes are very different from those that grow where the water is acid and deficient in lime. **Acid springs and flushes** tend to be commonest in the uplands, but even these tend to be relatively nutrient rich in comparison to the surrounding land because they have accumulated nutrients washed down through the bedrock, whilst the surrounding soils have often been extensively leached by very high rainfall. More **base-rich springs and flushes** are rarer, but are of exceptional biodiversity value.

The low flow volume of most springs and flushes allows the development of a thick muddy substrate on all but the steepest gradients. Rich organic material combined with well-oxygenated water provides a highly productive resource for a surprisingly diverse community of plants and animals. In practice this means that diversity in spring fed flushes tends to be very much greater than it is in those derived from surface water run-off.

1.2 National and International Context

Springs and flushes are small-scale localised habitats, but are widespread throughout the uplands of Britain.

2. Dumfries & Galloway Status

2.1 Recent Trends

As far as is known, there have been no significant recent changes to upland springs and flushes.

2.2 Current Distribution

Spring-fed flushes in upland areas are widespread and not uncommon in Dumfries & Galloway.

2.3 Site Examples

Important flush communities are found in the **Moffat Hills** (SAC/SSSI).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with upland springs and flushes, and the following action plans may also contain relevant information: Fens, Acid Grasslands, Inland Rock Outcrops, Upland Heaths.

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Upland springs and flushes are often dominated by mosses and liverworts. Typical species of **acid flushes** include the bright green Fountain Apple-moss *Philonotis fontana* and the brilliant yellow-green Marsh Forklet-moss *Dicranella palustris.* Cow-horn Bog-moss *Sphagnum denticulatum*, with its stout curved red-gold shoots, is a common plant in springs which emerge through peaty soils.

The most common liverwort in springs and flushes is Water Earwort *Scapania undulata*, but Cordate Flapwort *Jungermannia exsertifolia* is characteristic of stony upland flushes, where it often forms extensive turfs. It also grows in springs as rather spongy mounds.

The greatest diversity of species occurs in **base-rich upland flushes**, with species such as Lesser Clubmoss *Selaginella selaginoides* and Flat-leaved Bog-moss *Sphagnum platyphyllum,* the most base-demanding *Sphagnum* that occurs uncommonly in Dumfries & Galloway at the edges of open stony calcareous flushes. There are also a few regional records for Rigid Bog-moss *Sphagnum teres* in moderately base-rich flushes, often in a narrow band alongside the flush. Warnstorf's Bog-moss *Sphagnum warnstorfii* grows in a similar habitat.

A number of rare species also occur in this habitat: Varnished Hook-moss *Hamatocaulis vernicosus* is a plant of neutral flushes, especially springheads where alkaline water breaks through an acid peatland, or areas where alkaline flushes spread on to acid flushed ground. In Dumfries & Galloway it was recently refound at its former site in the Dalveen Pass. Water Grimmia *Schistidium agassizii*, a moss with few British records, has been recorded from flushed igneous outcrops in a valley in the Galloway Hills. *Splachnum vasculosum* was found on dung in springs and flushes at high altitude in the Moffat Hills in 1957 and 1985. Duval's Thread-moss *Bryum weigelii* is also recorded from flushes in the Moffat Hills.

3.2 Flowering Plants (very high importance)

Though springs and flushes may represent only a very small part of the total area of an upland site, they are distinct vegetation communities in their own right. A number of rare or uncommon flowering

Starry Saxifrage is found in higher altitude open flushes. White Coomb, July 2007. (Peter Norman)

plants are associated with them in Dumfries & Galloway: Hairy Stonecrop *Sedum villosum,* Starry Saxifrage *Saxifraga stellaris,* Mossy Saxifrage *Saxifraga hypnoides,* Pale Forget-me-not *Myosotis stolonifera*, Alpine Sawwort *Saussurea alpina,* Alpine Rush *Juncus alpinoarticulatus*, Hair Sedge *Carex capillari,* Sheathed Sedge *Carex vaginata,* Bog Orchid *Hammarbya paludosa* and Alpine Foxtail *Alopecurus borealis.* More typical species include Butterwort *Pinguicula vulgaris,* Carnation Sedge *Carex panicea* and Star Sedge *Carex echinata*.

Taller and more continuously vegetated flushes, merging into fens and marshes, occur wherever the lie of the land concentrates the flow of surface water into hollows, gullies and valley bottoms. Sedges and rushes are more common here than bryophytes.

3.3 Invertebrates (high importance)

Springs and flushes on wet muds tend to be the most densely-vegetated and to have the richest invertebrate fauna, those on peat are often very acid and sustain fewer species. Some spring and flush invertebrates are at least partially subterranean and a number are aquatic, frequently occurring in the upper sections of seepages. Microscopic aquatic animals occur in enormous numbers, up to 16 million protozoans per square metre of *Sphagnum* moss. Examples of larger aquatic species include the water beetles *Hydroporus longulus* and *Hydraena britteni*. Other invertebrate groups frequently encountered in springs and flushes include spiders, flies, and aphids. A number of very rare snails and craneflies have also been recorded from springs and flushes in northern England, but little survey work has been completed in Dumfries & Galloway.

3.4 Birds (high importance)

A number of upland waders and other birds feed on the invertebrates associated with springs and flushes. Such invertebrates are crucial for the survival of Red Grouse *Lagopus lagopus* and Black Grouse *Tetrao tetrix* chicks. In winter, springs and flushes become even more important for feeding birds when other ground is frozen and invertebrates are otherwise unobtainable. Similarly, they assume greater importance in dry periods during the breeding season, an increasingly common occurrence in recent years.

3.5 Fungi and Lichens (medium importance)

A few lichens are specialists of springs and flushes, including *Polyblastia cruenta*, which forms an inconspicuous dark brownish-green layer over submerged stones in acid springs, and the distinctive bright orange *Lonaspis lacustris*, which is also common on stones.

3.6 Reptiles and Amphibians (medium importance)

Common Frogs *Rana temporaria* abound in upland springs and flushes, and Common Toads *Bufo bufo*, Common Lizards *Zootoca vivipara* and Adders *Vipera berus* also hunt in this habitat.

Adder (Laurie Campbell)

4. Environmental, Economic & Social Importance of Biodiversity

- Water from upland springs has long been associated with many religions and is believed to have therapeutic qualities. The town of Moffat is founded on such associations.
- Around 30 brands of natural spring water, which by law must come from an unpolluted underground source, be free from microbial contamination and have received no treatment apart from filtration, are currently sold in the UK. None is collected from upland springs in Dumfries & Galloway, which is maybe just as well as the plant life of the original spring rarely survives the process. However, upland springs do supply a number of private water supplies.
- Scottish spring water is the basic liquid from which whisky is made.

5. Factors affecting the Habitat

- Sheep, cattle, deer goats, hares and rabbits graze in springs and flushes and their **trampling and poaching** may help to keep the cover of vegetation open and prevent encroachment of trees and shrubs. However, in some places deer can badly damage springs. They wallow in springs and flushes in summer, coating themselves with peat in order to discourage flies and to protect themselves from the heat of the sun.
- Large scale **developments** such as open-cast mining can destroy natural springs and flushes, and such features are almost impossible to reinstate following restoration.
- Springs and flushes are susceptible to damage by **quad-bikes and recreational activities.**

FENS

Priority Action (FE1)

Examine the potential for the enhancement and restoration of fens on a catchment scale, as part of a mosaic of wetland habitats.
Target: Complete a study in at least one catchment by 2012.
Lead Partner: Scottish Environment Protection Agency/Catchment Plan Steering Groups.

Floodplain fen at Dow Lochs, Cree Valley. June 2004 (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Fens are minerotrophic peatlands (peatlands with a water chemistry influenced by the mineral rocks and soils of source areas, as well as by rainfall). Ground water lies close to the surface throughout the year. Where the water is derived from base-poor rock they are known as **poor-fens** and where the water is base enriched they are called **rich-fens**, but there are also intermediate forms.

Fens are subclassified depending on the ground water source and water quality: topogenous fens are subject to generally vertical water movements in the peat or soil. They occur in poorly drained areas such as basins and floodplains where the water table is permanently high. Soligenous fens occur on sloping ground where water movements are predominantly lateral, such as springs, rills and flushes and valley mires. There are also significant differences between lowland and upland fens, but many fens consist of a complex assemblage of vegetation types, which can be rich and varied.

1.2 National and International Context

Fens have been reduced to a fragment of their former size throughout Europe, with a significant proportion of European rich-fens in the UK and Sweden. In the UK, fens are widespread but uneven in their distribution, with concentrations in East Anglia, northern England and north Wales. In 1998 there was approximately 3370km^2 of fen, marsh and swamp in Scotland, the majority likely to be marsh. Dumfries & Galloway has a number of fens, which cover approximately 250ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little deliberate drainage or loss of fens in recent years, but several have deteriorated in quality as a result of loss of appropriate management and/or land use changes on adjacent land.

2.2 Current Distribution

Fens are scattered across Dumfries & Galloway, often where the topography of drumlins, gorsey knolls and hollows has allowed their formation. Some rich-fens are also associated marginal areas of lochs and other waterbodies.

2.3 Site Examples

The **Cree Valley** floodplain between Newton Stewart and Clachaneasy, particularly within the RSPB's Wood of Cree reserve, is one of the best examples of hydroseral bog/fen development in Scotland. There is also 50ha on the RSPB's **Ken-Dee Marshes** reserve. Other important sites include **Black Loch** near Ae (SSSI), **Perchall Loch** near Lockerbie (SSSI) and **Newlaw Moss** near Dundrennan (SSSI).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with fens, and the following action plans may also contain relevant information: Eutrophic Lochs Mesotrophic Lochs, Oligotrophic Lochs, Swamps, Reedbeds, Marshes, Upland Springs and Flushes.

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Due to the limited extent of fens in the UK, many fen mosses and liverworts are now scarce. *Imbricate Bog-moss Sphagnum affine* is known from a number of sites in Dumfries & Galloway. It is found in very wet poor-fens, as well as other wetland habitats. Twisted Bog-moss *Sphagnum contortum* is one of the most base-demanding bog-mosses, restricted to rich-fens and flushes and rare in Dumfries & Galloway. Marsh Fern *Thelypteris palustris* is a rare species, found at Newlaw Moss and a very few other sites in Dumfries & Galloway but virtually absent from the rest of Scotland.

Lustrous Bog-moss Sphagnum subnitens. Carrick, Gatehouse of Fleet, June 2007. (Peter Norman)

3.2 Flowering Plants (very high importance)

Up to a third of the UK's native higher plant species are associated with fens across the country. The nationally scarce Elongated Sedge *Carex elongata* is found at Wood of Cree as well as on part of Ken-Dee Marshes. Water Sedge *Carex aquatilis*, which is restricted in the UK, is reasonably common in Dumfries & Galloway. Other notable plants include Purple Small Reed *Calamagrostis purpurea*, Greater Spearwort *Ranunculus lingua,* Purple Flag Iris *Iris versicolor* and Broad-leaved Cotton-grass *Eriophorum latifolium*.

3.3 Invertebrates (very high importance)

Fen habitats support thousands of invertebrate species including more than half the UK's dragonfly species, as well as a large number of aquatic beetles. A number of important invertebrates are known from fens in Dumfries & Galloway. These include: A jumping spider *Sitticus floricola,* known from just a handful of British fens and bogs including Kenmure Holms and Stroan Loch; the Large Amber Snail *Succinea putris* inhabiting fens and other wetlands at the northern edge of its range; a ground beetle *Carabus granulatus* restricted to marshes and fens in Britain; a hoverfly *Chrysogaster cemiteriorum* found in fens, wet meadows and valley bogs, at the northern edge of its British range; and the nationally scarce ground beetle *Pterostichus anthracinus,* found on shallow-profiled water margins and ditch-sides.

The caterpillars of Small Pearl-bordered Fritillary *Boloria selene* feed on Marsh Violet, and this butterfly is possibly more common on fens and marshes than in other habitats in Dumfries & Galloway.

3.4 Birds (high importance)

Fens support a number of breeding birds, including Water Rails *Rallus aquaticus*, Snipe *Gallinago gallinago*, Curlews *Numenius arquata*, Sedge Warblers *Acrocephalus schoenobaenus,* Grasshopper Warblers *Locustella naevia* and Reed Buntings *Emberiza schoeniclus*. UK Marsh Harrier *Circus aeruginosus* populations are increasing. This species has already bred recently in Dumfries & Galloway, but is likely to make more use of nesting opportunities in the future. The very rare Spotted Crake *Porzana porzana* has also bred in the past, and may still do so but is easily overlooked. The dense undisturbed nature of the habitat makes it of great value to breeding wildfowl and some areas support roosts of wintering Starlings *Sturnus vulgaris* and wintering raptors, particularly Hen Harriers *Circus cyaneus.* The habitat is also important for migratory and wintering Snipe and Jack Snipe *Lymnocryptes minimus*.

3.5 Mammals (high importance)

Fens of the region provide essential daytime cover and laying up sites for Otters *Lutra lutra*. The quiet, undisturbed cover provided by fen vegetation is also

of importance to Water Shrews *Neomys fodiens,* Water Voles *Arvicola terrestris* and the most northerly population of Harvest Mice *Micromys minutus* in the UK.

3.6 Reptiles and Amphibians (medium importance)

Five amphibian species are found in fens in Dumfries & Galloway, namely Common Frogs Rana temporaria, Common Toads Bufo bufo, Great Crested Newts *Triturus cristatus*, Smooth Newts Lissotriton vulgaris and Palmate Newts Lissotriton helvetica.

3.7 Fungi and Lichens (medium importance)

A number of specialist fungi can be found on fens, such as Fen Puffball *Bovista paludosa*, though there has been little assessment of this habitat for fungi in Dumfries & Galloway.

Angelica, typical of the tall vegetation in rich fens. Lochaber Loch, August 2007. (Peter Norman)

4. Environmental, Economic & Social Importance of Biodiversity

- Fens play an important part in the water cycle and in certain locations provide critical water storage functions that alleviate flooding.

5. Factors affecting the Habitat

- The total area of fen habitat in Dumfries & Galloway is small and there are critically **small populations of several key species**.
- Past **drainage** of surrounding areas of land for conversion to agriculture has lowered water tables and led to drying of remnant fen habitats.
- Nutrients from **agricultural run-off** and other sources leads to eutrophication of fen waters. This is likely to lead to a loss of aquatic vegetation and increased incidence of algal blooms, and may boost aggressive plants such as reed, which then become dominant at the expense of herb rich fen. Valley fens are particularly susceptible to agricultural run-off.
- **Afforestation** within catchments can lead to drying.
- **Loss of grazing** on fens results in a build up of vegetation layers, drying and succession to species-poor fen and ultimately carr.
- Fens on the Ken-Dee system are regularly flooded by **hydro-generation** operations, which can affect breeding birds in spring.

6. Strategic Actions

6.1 Recent and current activity

- **RSPB** manage fen habitats on their Wood of Cree, Ken-Dee Marshes and Kenmure Holms reserves for the benefit of breeding and wintering birds.

6.2 Other recommended actions

- **Manage catchments** to enable fens to be maintained as part of a mosaic of wetland habitats.
- **Avoid water abstraction**, including from underground aquifers.
- **Minimise nutrient enrichment** from the application of fertilisers within the water catchment and consider buffer zones around fens.

RAISED BOGS

Priority Action (RB1)

Investigate funding for restoration of Racks and Ironhirst Mosses as part of a Lochar Mosses complex.
Lead Partner: Regional Proposal Assessment Committee.

Priority Action (RB2)

Raise awareness of the damage caused by extraction and use of horticultural peat, concentrating on selected high-profile events such as National Bog Week.
Target: Arrange 10 public events by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Restoration of Kirkconnell Flow through tree removal. March 2005. (SNH)

1. Habitat Description

1.1 Physical Characteristics

Raised bogs consist of a deep accumulation (up to 12m) of water-logged peat and a surface layer of plants (called the acrotelm). The surface of the bog is raised above the level of the water table and therefore all nutrients and water come from rainfall (an ombrotrophic system). Raised bogs where acrotelm is undisturbed and rich bog-moss communities typically occur are termed 'primary', whilst 'secondary' bogs occur where the bog has been damaged but where the water table has been stabilised because the drainage pattern has become blocked. Secondary bogs can be active (laying down peat) or degraded (often capable of restoration, but not always). *Sphagnum* species abundance is of critical importance to the creation of the strongly acidic conditions characteristic of ombrotrophic bogs.

Relatively undisturbed lowland raised bog surfaces are not uniform; they are made up of an almost continuous carpet of bog-mosses with a microtopography of **hummocks and hollows** providing a range of conditions that support plants and animals. **Bog pools** are not a natural component of bogs, their frequency and pattern depending on the history of human activities. They present a very hostile environment to most species.

In the zone around raised bogs where water draining the bog meets that from adjoining mineral soils a fen type vegetation, termed the **lagg**, sometimes forms that has more nutrients and a greater species diversity. Although colonisation by trees usually leads to the loss of the bog, in some circumstances scattered scrub and **bog woodland** can exist in a stable relationship with bog communities.

1.2 National and International Context

Raised bogs are found in most EU countries, but only Finland, Sweden, UK and Ireland hold significant concentrations. In the UK they are found in upland and lowland situations but tend to be clustered in certain areas that have conditions particularly suitable for formation, such as the Scottish central belt, north-west England, Northern Ireland and both sides of the Solway. It is estimated that there once were at least 800 raised bogs covering more than 700,000ha in the UK but since around the start of the 19th century the extent of primary raised bog has decreased by around 94% from 95,000ha to around 6,000ha, with only 500ha remaining in England. Dumfries & Galloway has approximately 3.5% of UK's raised bogs.

2. Dumfries & Galloway Status

2.1 Recent Trends

The conservation importance of raised bogs has become more widely recognised in recent years, leading to changes in national policy and a number of restoration projects, including experiments to reintroduce grazing. From 2001 to 2005, as part of the Restoration of Scottish Raised Bogs Project, tens of thousands of naturally regenerated and planted conifers were removed from two sites in Dumfries

& Galloway – Kirconnell Flow and Longbridge Muir. Further west, smaller numbers were removed from Carsegowan Moss, and as part of a separate project, 64ha of Moss of Cree was cleared of conifers. Drainage ditches at these sites have been blocked.

However, most of Dumfries & Galloway's area of remaining raised bogs remains under conifer plantation, and there are extant planning permissions for peat extraction on several other sites.

2.2 Current Distribution

Dumfries & Galloway's largest raised bogs occur in lowland areas on the inner Solway plain and adjacent to the Cree estuary. There are a few raised bogs in the uplands, and several that show characteristics of both raised and blanket bogs as well as the transition habitats in-between.

2.3 Site Examples

On the Solway plain a number of raised bogs were created under estuarine conditions. These now form the largest and most extensive raised bogs in the region, and include **Kirkconnell Flow** (SAC/SSSI/NNR), and **Longbridge Muir** (SAC/SSSI). There are many smaller sites including **Bell's Flow** (SSSI), **Raeburn Flow** (SAC/SSSI), **Ring Moss** (SSSI), **Kelhead Flow** (LWS), **Cowgarth Flow** (LWS), **Cadgill Flow** (LWS), **Burnfoothill Moss** (LWS), **Greenwrae Flow** (LWS), **Merkland Moss** (LWS), and **Carsegowan Moss** (SAC/SSSI). **Redhills Moss** (LWS) **Catherinefield Moss** (LWS) are remnants of the Lochar Moss. **Ellergower Moss** (SSSI) is one of the few remaining examples of an intact upland raised bog.

Several large sites remain under conifer plantations, although some are probably capable of restoration. These include **Craigs, Ironhirst** and **Racks Moss** (all part of the Lochar Moss complex), **Rascarrel Moss** (LWS) and most of **Moss of Cree** (LWS).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with raised bogs, and the following action plans may also contain relevant information: Blanket Bogs, Fens, Native Wet Woods, Conifer Plantations.

Carpet of Red Bog-moss Sphagnum capillifolium. Kirkconnell Flow, February 2008. (Peter Norman)

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Bog-moss *Sphagnum* abundance is of critical importance to the creation of the strongly acidic conditions characteristic of ombrotrophic bogs. In fact it could be argued that *Sphagnum* does not just occur on raised bogs, it actually *is* raised bogs. Thirty of the 36 UK species have been recorded in Dumfries & Galloway, often from raised bogs, including Feathery Bog-moss *Sphagnum cuspidatum* and Cow-horn Bog-moss *S. denticulatum* in pools, Red Bog-moss *S. capillifolium* and Papillose Bog-moss *S. papillosum* on hummocks, and Blunt-leaved Bog-moss *S. palustre* forming carpets between the hummocks. The scarce Golden Bog-moss *Sphagnum pulchrum* occurs on pool edges, and the very rare Baltic Bog-moss *Sphagnum balticum,* was identified on Racks Moss in 1960 but is now probably extinct following afforestation. A wide diversity of other mosses and liverworts are also found on raised bogs, in addition to bog-mosses.

Raised bogs are not as important for ferns as mosses, but the scarce Royal Fern *Osmunda regalis* is still extant on Lochar Moss.

3.2 Invertebrates (very high importance)

Localised invertebrates such as Black Darter dragonflies *Sympetrum danae* and Large Heath butterflies *Coenonympha tullia* are found on some lowland raised bog sites in the region. Marsh Fritillary butterflies *Euphydryas aurina* were last recorded in Dumfries & Galloway on the Lochar Moss complex in the 1970s, but are now extinct following afforestation.

Many scarce invertebrates in Dumfries & Galloway are closely linked to *Sphagnum,* including the money spiders *Maro lepidus, Bathyphantes setiger, Centromerus levitarsis* and *Erigone welchi,* the water beetle *Laccobius atratus* and Sphagnum Bugs *Hebrus ruficeps*. All of these have a very restricted Scottish, if not UK, distribution. The pond skater *Gerris gibbifer* is known in Scotland only from Dumfries & Galloway. It was last recorded on **bog pools** Lochar Moss in 1946, prior to afforestation, but still remains on Kirkconnell Flow and in non-bog habitat on the Black Water of Dee. A nationally rare jumping spider *Sitticus floricola* was recorded at Kirkconnell Flow in 2006.

Large Heath butterfly. (Laurie Campbell)

Bog woodland supports a number of specialist species, including Bog Bush Crickets *Metrioptera brachyptera* in open woodland with Cross-leaved Heath and Purple Moor Grass, and Bilberry Pug moths *Pasiphila debiliata* in birch woodland with abundant Blaeberry at their only Scottish location at Kirkconnell Flow. Although not restricted to bog woodland, the very rare Six-spotted Pot Beetle *Cryptocephalus sexpunctatus* is also known from the latter site.

Round-leaved Sundew. (Peter Norman)

3.3 Flowering Plants (high importance)

Typical species include Round-leaved Sundew *Drosera rotundifolia,* Hare's-tail Cottongrass *Eriophorum vaginatum* and Deer Grass *Trichophorum cespitosum.* Cranberry *Vaccinium oxycoccos* and Bog Rosemary *Andromeda polifolia*, though scarce in much of Britain, are abundant on many raised bogs in Dumfries & Galloway. Less common species include Great Sundew *Drosera anglica* and Oblong-leaved Sundew *Drosera intermedia.* Species associated with **bog pools** include White Beak-sedge *Rhynchospora alba* and Bog Sedge *Carex limosa* both frequently found on bare wet peat on pool margins, sometimes in shallow standing water.
It is not known if any stable **bog woodland** exists in Dumfries & Galloway, but a similar habitat, consisting of scattered trees on the central areas or more usually on the lagg, is found on most local bogs. Birch *Betula* spp. and Bog Myrtle *Myrcia gale* are typical species.

3.4 Reptiles and Amphibians (high importance)

Adders *Vipera berus* occur on most raised bogs, often the only suitable habitat for them within extensive areas of improved farmland. Common Lizards *Zootoca vivipara* may also occur, but the water is generally too acidic for amphibians to breed.

3.5 Fungi and Lichens (medium importance)

A number of species of fungi are adapted to bogs, or to the plants growing in them. This is especially the case with *Sphagnum* mosses, which have a specialised fungal flora including Bog Bell *Galerina paludosa.* However, most bog fruit bodies are small, such as those of several species of the genus *Mycocalia*, closely related to the bird's-nest fungi, which grow amongst wet vegetation.

3.6 Birds (low importance)

Breeding birds do not occur in high densities on raised bogs. Skylarks *Alauda arvensis* and Meadow Pipits *Anthus pratensis* are probably the commonest breeding species, with smaller numbers of Stonechats *Saxicola torquatus*. Although the habitat appears suitable for feeding Nightjars *Caprimulgus europaeus*, there are only a few records of this species breeding on raised bogs in Dumfries & Galloway. Red Grouse *Lagopus lagopus* and Black Grouse *Tetrao tetrix* no longer occur on most lowland raised bogs.

Birds of prey such as Hen Harriers *Circus cyaneus*, Merlins *Falco columbarius* and Short-eared Owls *Asio flammeus* hunt over raised bogs outside the breeding season, and there are a number of important roosts.

4. Environmental, Economic & Social Importance of Biodiversity

- Being supplied with water and nutrients entirely from the atmosphere, raised bogs are sensitive indicators of climate change and pollution.
- The process of peat formation locks up atmospheric carbon for thousands of years. Recent research has suggested that 3.5 times the quantity of carbon is locked up in peat than in the world's tropical rainforests. Drainage of peat releases this carbon back into the atmosphere. However, active peatlands give off methane, which is a 'greenhouse gas'.
- Peatlands provide a historical record of past climates, vegetation and human history. Stored within the peat are plant and animal remains, pollen grains, human artefacts and even occasionally 'bog bodies'. Scientists and archaeologists use these remains to reconstruct Scottish landscape history and prehistory.
- Small-scale peat extraction for domestic use has been undertaken in Dumfries & Galloway, and has not significantly damaged any sites. Although the use of peat in horticulture has provided many benefits, and supports an extraction industry, use of all horticultural peat is incompatible with biodiversity conservation.

5. Factors affecting the habitat

- **Afforestation** of bogs results in loss of habitat, although this is often a very gradual process with bog conditions persisting for many years under the trees. Tree planting on neighbouring areas also dries out bogs and acts as an invasive seed source.
- Removal of **peat for fuel or horticultural use** results in loss of habitat. Planning permissions exist on a number of bogs.
- Use of bogs for **landfill sites** results in loss of habitat.
- **Livestock and game management** on bogs may damage habitat though drainage, trampling, burning, and contamination with feed and droppings.
- **Agricultural use of neighbouring areas** often reduces water levels on bogs, as a result of marginal ring-ditches and other drainage measures. Run-off from agricultural land (fertilisers and pesticides) may also damage bog ecology.
- **Water abstraction** within the catchment area may have an adverse effect on the hydrology of raised bogs. There has been little built development on bogs, but natural hydrology may be disrupted by **neighbouring developments** and associated roads.
- Drying out the raised bog allows **invasion by scrub and trees** which it turn speed up the drying out process and lead to the loss of special habitat and fauna.
- The mosaic created by domestic hand-cutting of peat provides a range of small-scale structures across a site, and is beneficial for some species. However, **cutting** is always damaging to the habitat when carried out on a part of the bog surface not previously worked or in areas where past peat extraction has been so extensive as to leave only a thin covering of peat over the mineral soil.
- **Climate change** may affect hydrology, habitat quality and species composition.

6. Strategic Actions

6.1 Recent and current activity

- **SNH** has undertaken a programme of mapping, identifying the location, condition and potential threats to peatlands in Scotland. Details are held within the Lowland Raised Bog inventory (LRBI).
- **Forestry Commission** policy includes a strong presumption against further forestry expansion on extensive areas (exceeding 25ha) of active raised bogs and degraded raised bogs capable of restoration to active status. It also encourages the conservation and restoration of peatland habitats within forests as part of the design and management of open ground.
- The **SNH** Peat Policy promotes the use of sustainable growing-media based on recycled organic materials in place of peat.
- A number of raised bogs, such as Kirkconnell Flow and Carsegowan Moss are managed as nature reserves, and promoted to the public by **SNH** and **Scottish Wildlife Trust**.

6.2 Other recommended actions

- **Survey** all raised bogs to at least Phase 1, ideally NVC, with an assessment of habitat condition where data not currently available.
- **Review existing planning consents** for the extraction of peat on all raised bogs and examine whether consents on non-severely degraded sites can be withdrawn. Ensure Forest Design Plans **identify areas of raised bog that have previously been planted**, and where viable that they restore these areas through removal of trees.
- Use the raised bog restoration schemes at Longbridge Muir and Kirkconnell Flow to **evaluate measures for conserving and managing lowland raised bogs** and to demonstrate best practice.
- **Phase out the use of horticultural peat** by all statutory agencies. Promote public use of horticultural alternatives.

BLANKET BOGS

Priority Action (BB1)

Restore degraded blanket bogs through the blocking of moorland 'grips' and drains, especially on designated sites, or those adjacent to designated sites.
Target: Identify suitable blanket bog locations by 2012.
Lead Partner: Southern Uplands Partnership/Regional Proposal Assessment Committee.

Bog pool with Bogbean. Silver Flowe, July 1999. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Blanket bog is characteristic of areas of the UK with an oceanic climate, which is cool with high and regular rainfall. In such areas blanket bogs can cover whole landscapes. A mantle of peat accumulates slowly over many years through the slow decomposition of mosses. This can reach depths exceeding 5m, although 0.5-3m is more typical. It occurs in wet hollows or on slopes of up to 30°, but typically forms over large expanses of undulating ground, hence the name blanket bog.

Blanket bogs are composed mostly of water held in *Sphagnum* mosses and are ombrotrophic, that is the water and mineral supply comes entirely from atmospheric sources (rainwater, mist and cloud-cover). Active blanket bogs are those in which the peat is still capable of accumulating through growth and impeded decay of *Sphagnum*. The water chemistry is nutrient-poor and the habitat is dominated by acidic plant communities. A blanket bog landscape may also contain minerotrophic systems (those that are affected by ground-water and the nutrients in it), such as springs, flushes, stream margins and valley mires. These will support different vegetation types that may also provide important sub-habitats.

The frequency of **bog pools** on the surface varies with local topography and geographical location, but they can be common on some blanket bogs.

1.2 National and International Context

In Europe, blanket bogs are found primarily in the UK and Ireland. The UK has an estimated 2,210,000ha of blanket bog with 1,759,000ha in Scotland, a significant proportion of the total global area, making it one of the most important international locations for this habitat. Blanket bogs are distributed mostly in the north and west of Britain from Devon to Shetland. The current area of blanket bog in Dumfries & Galloway is less than 50,000ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little recent loss of blanket bog to new afforestation or drainage, but many existing drainage systems continue to operate.

2.2 Current Distribution

Blanket bog in Dumfries & Galloway occurs from 70 metres above sea level on the Wigtownshire mosses, to altitudes of nearly 700 metres on the tops of Merrick/Kells and the Moffat Hills.

2.3 Site Examples

Blanket bogs occur on many of the hill ranges in Dumfries & Galloway, including **Merrick-Kells** (SSSI), **Moffat Hills** (SSSI), and **Lowther Hills** (SPA/SSSI). Within the Merrick Kells range **Silver Flowe** (SSSI/NNR/Ramsar) consists of almost 200ha of mostly blanket bog, although parts of the site grade into a raised bog type habitat. Areas of blanket bog are also found on **Cairnsmore of Fleet** (NNR/SSSI).

At lower altitude, there are a number of important blanket bogs in Wigtownshire, including **Mochrum Lochs** (SAC/SSSI), **Kirkcowan Flow** (SAC/SSSI), **Kilhern Moss** (SAC/SSSI), **Blood Moss** (SSSI), **Derskelpin Moss** (SSSI) and **Flow of Dergoals** (SAC/SSSI).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with blanket bogs, and the following action plans may also contain relevant information: Raised Bogs, Upland Heaths, Acid Grasslands.

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Bog-mosses, including Papillose Bog-moss *Sphagnum papillosum,* Soft Bog-moss *S. tenellum* and Magellanic Bog-moss *S. magellanicum*, are the principal peat forming species on blanket bogs. Austin's Bog-moss *Sphagnum austinii* and Rusty Bog-moss *Sphagnum fuscum* are virtually restricted to undisturbed raised and blanket bogs. Extensive surface patterning with Feathery Bog-moss *Sphagnum cuspidatum* **hollows** occurs at Kirkcowan Flow, whilst the increasingly uncommon Golden Bog-moss *Sphagnum pulchrum* normally grows around **bog pool** edges, and is a distinctive feature at Kilhern Moss.

Cloudberry. Mid Craig, Moffat Hills, July 2007. (Peter Norman)

3.2 Invertebrates (high importance)

Blanket bog is of great importance to many invertebrates such as spiders and leaf-hopper bugs. The nationally scarce ground beetle *Agonum ericeti* is associated with *Sphagnum* moss in a few Dumfries & Galloway bogs, along with the spider *Clubionia norvegica.* Large Heath Butterflies *Coenonympha tullia* also occur on blanket bogs, though not in the density found on raised bogs. Azure Hawker dragonflies *Aeshna caerulea* breed in shallow **bog pools** with *Sphagnum*. Outside of northern Scotland, their only UK sites are in the Silver Flowe area.

Azure Hawker dragonfly, restricted in the UK to the bogs of Silver Flowe and the Scottish Highlands. (Laurie Campbell)

The fringes of blanket bogs can support important marginal vegetation. Tussocky vegetation of taller *Molinia*, *Carex* or *Juncus* and the associated litter build-up provides cooler, more sheltered microhabitats for adult craneflies and drier sites for over-wintering invertebrates such as spiders. Ericaceous dwarf shrubs also support many heather-feeding moths and other insects, as well as providing a well-developed vegetation structure for spiders.

3.3 Birds (high importance)

Many areas of blanket bog are important for Black Grouse *Tetrao tetrix* which feed on the invertebrates and cotton grasses that can be abundant in these areas. Red Grouse *Lagopus lagopus* also occur, and

wading birds such as Curlews *Numenius arquata*, Golden Plovers *Pluvialis apricaria* and Dunlins *Calidris alpina* all nest on blanket bogs, though have become increasingly scarce in recent decades.

A number of birds of prey, such as Golden Eagles *Aquila chrysaetos*, Hen Harriers *Circus cyaneus*, Merlins *Falco columbarius* and Short-eared Owls *Asio flammeus* often hunt over blanket bogs.

3.4 Flowering Plants (medium importance)

Typical blanket bog plants include Cross-leaved Heath *Erica tetralix*, Crowberry *Empetrum nigrum*, Round-leaved Sundew *Drosera rotundifolia*, Bog Asphodel *Narthecium ossifragum*, and cotton grasses *Eriophorum* spp. Cloudberry *Rubus chamaemorus* forms a dense carpet on some blanket bogs in the east of the region. Bogbean *Menyanthes trifoliata* is typical of **bog pools**.

Tall Bog Sedge *Carex magellanica* is a perennial of **bog pools** and **hummocks** in *Sphagnum* bogs, or at the edges of gently sloping bogs where there is slight lateral water movement. It is thinly scattered in Britain with some colonies lost as a result of drainage and afforestation. A number of other species are rare outside of the Highlands, but have been found in Dumfries & Galloway. These include Bog Blaeberry *Vaccinium uliginosum,* recorded in the Moffat Hills, and Few-flowered Sedge *Carex pauciflora,* a very inconspicuous species that grows on and around hummocks, usually in association with *Sphagnum*.

3.5 Mammals (medium importance)

Water Voles *Arvicola terrestris* are usually thought of as mammals of lowland rivers, but as they have declined in such habitats, it has become clear that they also occur on blanket bogs and moorlands, although their presence is often not obvious. Indeed, this is their main habitat in some parts of Europe and upland populations appear to be surviving better than those in the lowlands of the UK. Red Deer *Cervus elaphus* wallow in bog pools to rid themselves of flies and parasites.

3.6 Reptiles and Amphibians (medium importance)

Adders *Vipera berus* are frequently found on blanket bogs.

Bog Bellcap Galerina sp. on Sphagnum mosses. Mid Craig, Moffat Hills. July 2007. (Peter Norman)

3.7 Fungi and Lichens (medium importance)

As with raised bogs, several species of fungi are adapted to the plants growing in blanket bogs, especially with *Sphagnum* mosses that have a specialised fungal flora including Bog Bell *Galerina paludosa.* However, most bog fruit bodies are small, such as those of several species of the genus *Mycocalia*, closely related to the bird's-nest fungi, which grow amongst wet vegetation.

3.8 Fishes (low importance)

Salmon *Salmo salar* and Sea/Brown Trout *Salmo trutta* benefit from the quality of waters produced by peatland catchments.

4. Environmental, Economic & Social Importance of Biodiversity

- Peatlands play a significant role as carbon dioxide sinks in minimising global warming (see Raised Bogs).
- Blanket bogs play a vital role in many catchments in the maintenance of water quality. Most of Scotland's drinking water comes from catchments dominated by bogs.
- Without the protective layer of peat high rainfall would erode many of the less stable upland soils off the hill and into watercourses.
- Where numbers of birds allow, grouse shooting is a sustainable economic use of upland areas. Blanket bogs support many invertebrates, especially craneflies that are an essential component of the diet of grouse chicks.

5. Factors affecting the habitat

- **Afforestation** over extensive tracts of blanket bog and adjacent areas, often accompanied by furrowing of the ground, affects the hydrology and species composition. This increases as the trees mature, require more water and cast more shade.
- **Drainage** of blanket bogs and their margins has been widespread in Dumfries & Galloway. Drainage ditches, both new and old, lower the water table and may initiate erosion, oxidation of the peat and modification the surface patterning, leading to the loss of *Sphagnum* hollows. Even unmaintained old drains continue to affect hydrology. Lowered water tables alter the species composition of the surface vegetation and have a detrimental impact on specialist invertebrates.
- **Heavy grazing** by sheep can have a significant impact on blanket bog vegetation, especially if there is supplementary feeding (which will increase the nutrient input) and other management measures such as drainage, burning or fencing. Grazing and trampling by feral goats affects some sites.

Blanket bog at Watch Knowe, next to Loch Skene, Moffat Hills. July 2007. (Peter Norman)

- **Uncontrolled burning** can lead to increased erosion and the loss of characteristic bog species, including the death of peat-forming species. These can slowly recover over time (more than 20 years), but the invertebrate population will be seriously affected
- The **application of fertilisers and lime** to increase stock grazing productivity will inevitably lead to nutrient enrichment of the water supply, modifying bog ecology to the detriment of biodiversity.
- **Acidification** from atmospheric deposition has altered the nutrient status of bogs, and hence the plant species composition. However, if lime is added to lochs, lakes and rivers as a treatment for acidification, this may also have a detrimental effect on adjacent areas of blanket bog.
- **Development**, such as wind farms and communication masts, together with associated infrastructure such as access and maintenance roads can cause significant hydrological disruption. Links to the national grid via landlines and pylons also has an impact on very fragile blanket bog during the construction phase.
- The bog surface is a fragile habitat and can be damaged by even modest levels of **recreational use**. This is usually restricted by the natural wetness of blanket bogs, sometimes making them dangerous places to walk, but localised areas can suffer severe erosion. There is also a fire risk from recreational use.

- **Erosion** exposes more of the peat to the atmosphere, increasing drying and oxidation of the peat. Hag erosion may be instigated, resulting in extensive patches of bare eroding peat both in gullies and flatter areas.

6. Strategic Actions

6.1 Recent and current activity

- **SNH** has undertaken a programme of mapping, identifying the location, condition and potential threats to peatlands in Scotland. Details are held within the Scottish Blanket Bog inventory (SBBI).
- **Forestry Commission** policy includes a strong presumption against further forestry expansion on extensive areas (exceeding 25ha) of active blanket bog averaging 1m or more in depth or any associated peatland where afforestation could alter the hydrology of such areas. It also encourages the conservation and restoration of peatland habitats within forests as part of the design and management of open ground.

6.2 Other recommended actions

- **Manage at the scale of hydrological units or catchments.** Operations some distance away from the ombrotrophic *Sphagnum* communities can have a devastating effect if they are within the same hydrological unit. In order to conserve characteristic bog communities, it is necessary to look beyond the boundaries of a particular site.
- **Monitor the impact of recreational use** of blanket bogs. **Determine in detail the area, extent and condition** of blanket bog within Dumfries & Galloway.
- Use sites such as Silver Flowe NNR to **demonstrate good practice**.
- **Raise public and landowner awareness** of blanket bog through guided walks, talks, publications, press releases, and environmental education opportunities, including National Bog Week.
- Identify and **evaluate opportunities for restoration** of blanket bog habitats as forests are re-designed at felling and re-stocking. Where hydrologically possible, restore blanket bog adjacent to SSSIs such as Kirkcowan Flow, Derskelpin Moss, Flow of Dergoals and Ring Moss.

PURPLE MOOR-GRASS & RUSH PASTURES

Priority Action (PMG1)

Determine the extent, distribution, composition and status of Purple Moor-grass and rush pastures in Dumfries & Galloway.
Target: Complete study by 2012.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

Priority Action (PMG2)

Restore Purple Moor-grass and rush pastures.
Target: Restore 8ha by 2015.
Lead Partner: Regional Proposal Assessment Committee/Farming & Wildlife Advisory Group.

1. Habitat Description

1.1 Physical Characteristics

Purple Moor-grass and rush pastures occur on poorly drained sites in lowland-mid altitude areas with high rainfall. The soils are usually acidic, supporting a distinctive species-rich vegetation community with abundant Purple Moor-grass and Sharp-flowered Rush. This habitat is often found in conjunction with wet heath, scrub and dry grassland, which contribute to a patchwork of diverse habitats that supports high biodiversity.

1.2 National and International Context

Purple Moor-grass and rush pastures occur throughout western Europe. The total estimated extent of this habitat in the UK is around 56,000ha, considerably more than survives in the rest of Europe, with the possible exception of the Republic of Ireland. It is found in south-west England, south Wales and western Scotland as far as northern Argyll. An estimated 4,500ha occurs in Scotland. The total extent in Dumfries & Galloway is not accurately known, but there is at least 65ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

Recent trends are not known.

2.2 Current Distribution

Purple Moor Grass and rush pasture is found in Galloway at altitudes up to 300m, and at least 4 Sites of Special Scientific Interest in the region include this habitat.

2.3 Site Examples

The following Sites of Special Scientific Interest contain elements of purple moor grass and rush pasture, but a complete survey of the extent of this habitat has not been carried out: **Skyreburn** (SSSI), **Cleugh** (SSSI) **Bailliewhirr** (SSSI) and **Dowalton Loch** (SSSI).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with Purple Moor-grass and rush pastures, and the following action plans may also contain relevant information: Fens, Acid Grasslands, Neutral Grasslands, Upland Springs and Flushes.

3. Importance for Associated Species

3.1 Non-flowering Plants (high importance)

A diverse moss and liverwort flora is found in many Purple Moor-grass and rush pastures. Bog-mosses such as Compact Bog-moss *Sphagnum compactum*, Cow-horn Bog-moss *S. denticulatum* and Blunt-leaved Bog-moss *S. palustre* can be common, though rarely forming the carpets found on bogs.

3.2 Flowering Plants (high importance)

The habitat is characterised by plant species such

Grass of Parnassus. Stronach Hill, Skyreburn, September 2007. (Peter Norman)

as Fairy Flax *Linum catharticum*, Field Gentian *Gentianella campestris*, Quaking Grass *Briza media,* Frog Orchid *Dactylorhiza viridis*, Greater Butterfly Orchid *Platanthera chlorantha*, Spignel *Meum athamanticum*, Whorled Caraway *Carum verticillatum* and Marsh Hawk's-beard. Many of these are locally or nationally uncommon.

3.3 Invertebrates (high importance)

Purple Moor-grass and rush pastures provide important areas for butterflies and moths such as the Small Pearl-bordered Fritillary *Boloria selene*, Scotch Argus *Erebia aethiops* and Narrow-bordered Bee Hawkmoth *Hermaris tityus*.

Scotch Argus, the characteristic butterfly of local Purple Moor Grass and rush pastures. (Richard Mearns)

3.4 Reptiles and Amphibians (medium importance)

All of the region's terrestrial reptiles and all of the common amphibians are found in Purple Moor-grass and rush pastures.

3.5 Birds (medium importance)

Breeding birds of purple moor grass and rush pasture include Lapwings *Vanellus vanellus,* Snipe *Gallinago gallinago,* Curlews *Numenius arquata* and Skylarks *Alauda arvensis.* Hen Harriers *Circus cyaneus,* Barn Owls *Tyto alba* and Short-eared Owls *Asio flammeus* are likely to feed over this habitat if they are nesting or wintering close by.

3.6 Fungi and Lichens (medium importance)

No species of fungi are restricted to Purple Moor-grass and rush pastures, but a wide range of unimproved grassland species occur, including waxcaps *Hygrocybe* spp. Field mushrooms *Agaricus* spp. may be found on more improved sites.

3.7 Mammals (low importance)

Although a wide variety of mammals may be found on Purple Moor-grass and rush pastures, including Brown Hares *Lepus europaeus* and high densities of small mammals, none are restricted to this habitat.

4. Environmental, Economic & Social Importance of Biodiversity

- Purple Moor-grass and rush pastures provide rough grazing for cattle and sheep.

5. Factors affecting the Habitat

- **Lack of information and understanding** about the distribution, quality and importance of this habitat leading to poor appreciation of its value.
- **Agricultural improvement** through drainage, cultivation and fertiliser applications.
- **Agricultural abandonment**, leading to rankness and scrub encroachment through lack of grazing.
- **Inappropriate management**, including overgrazing by sheep and burning.
- **Afforestation** on or adjacent to important sites.

6. Strategic Actions

6.1 Recent and current activity

- None known, except maintenance of this habitat on designated sites.

6.2 Other recommended actions

- Include information on the importance of this habitat and its sensitivity to land use changes in **publicity and interpretation** materials.

Purple Moor-grass and rush pasture at Stronach Hill, Skyreburn. August 2006. (Peter Norman)

CALCAREOUS GRASSLANDS

Priority Action (CG1)

Designate calcareous grasslands as Local Wildlife Sites and provide management advice.
Target: All appropriate sites designated as LWS by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Habitat Description

1.1 Physical Characteristics

Calcareous grassland in former limestone quarry at Kelhead. June 2007. (Peter Norman)

Calcareous grasslands occur on shallow base-rich rocks such as chalk, limestone, serpentine and old red sandstone. They tend to be dry grasslands because of the free-draining nature of the soil and are rich in calcium but poor in available nitrogen and phosphate. A range of different calcareous grasslands occur across the UK, maintained by grazing livestock, particularly where low-intensity farming practices have survived. It is also found on roadside verges, old limestone quarries and railway cuttings.

1.2 National and International Context

There is an estimated 40,000-65,000ha of calcareous grassland throughout the UK, but it is restricted to areas of the country with suitable geology. Most lowland grasslands occur on chalk with concentrations in Wiltshire, Dorset and the South Downs. Carboniferous limestones in the north of England are another significant source of lime-rich soils, particularly in the north Pennines, Cumbria and north Lancashire. Calcareous grasslands are rare in Scotland with an estimated extent of little more than 50ha with less than 10ha in Dumfries & Galloway.

2. Dumfries & Galloway Status

2.1 Recent Trends

Scrub encroachment on disused quarries may have resulted in a decline in the quality of calcareous grasslands in recent years.

2.2 Current Distribution

Calcareous grasslands in Dumfries & Galloway are limited to small fragments on limestone, mostly in disused quarries in Dumfriesshire. However, small pockets of lime-loving plants are also found on isolated areas of base-rich glacial drift within acid grasslands.

2.3 Site Examples

Former industrial sites include flooded **lime pits around Eaglesfield**, **Barjarg Lime Kiln** and **Kelhead Quarry** (LWS). Pockets of base-rich grassland can also be found amongst other habitats at **Bailliewhirr** (SSSI), **Cleugh** (SSSI), **Skyreburn** (SSSI) and **Stranfasket**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with calcareous grasslands, and the following action plans may also contain relevant information: Coastal Sand Dunes, Coastal Cliffs and Slopes, Neutral Grasslands, Acid Grasslands, Upland Springs and Flushes, Quarries and Mineral Workings.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Common Twayblade orchids. (Peter Norman)

Calcareous grasslands are considered as the richest and most species diverse of all grassland types for flowering plants. In Dumfries & Galloway, typical species include Wild Thyme *Thymus praecox,* Quaking Grass *Briza media,* Fairy Flax *Linum catharticum* and Common Rockrose *Helianthemum nummularium*. They also contain a number of locally scarce species, such as Field Gentian *Gentianella campestris* and Hairy Rock Cress *Arabis hirsuta,* although these are not confined to calcareous grasslands. There are old records of plants of calcareous soils, such as Herb Paris *Paris quadrifolia* from upper Nithsdale and the Dundrennan area.

3.2 Invertebrates (high importance)

Calcareous grassland supports a rich diversity of invertebrates. This is particularly so where it forms a

mosaic with other habitats such as scrub, rock outcrops and sparse bracken. Species include butterflies such as Common Blue *Polyommatus icarus* and Small Heath *Coenonympha pamphilus*; grasshoppers such as Meadow *Chorthippus parallelus* and Common Green *Omocestus viridulus*; bumblebees such as the Common Carder *Bombus pascuorum* and Red-tailed *B. lapidarius* ; and ants such as Yellow Meadow Ant *Lasius flavus.* None of these insects are confined to this habitat. Although there are rare species more strongly associated with this habitat elsewhere in Britain, no detailed surveys have been completed in Dumfries & Galloway.

Common Blue butterfly. (Peter Norman)

There are several molluscs in Dumfries & Galloway that have a stronger association with calcareous grasslands. This habitat is particularly important for snails because most need calcium in considerable quantities for their shells. Species include Wrinkled Snail *Candidula intersecta,* Moss Chrysalis Snail *Pupilla muscorum* and Ribbed Grass Snail *Vallonia costata.*

3.3 Fungi and Lichens (high importance)

There are few species of fungi restricted to calcareous grasslands. Their ecology depends much more on the presence of other species, especially mosses, rather than directly on the pH of the soil, though soil pH does of course influence the presence of such plant associates. Nevertheless, several species seem to prefer calcareous grassland, including Snowy Waxcap *Hygrocybe virginea var. ochraceopallida*, Big Blue Pinkgill *Entoloma bloxamii* and Grassland Puffball *Lycoperdon lividum.*

3.4 Reptiles and Amphibians (medium importance)

The dry nature of calcareous grasslands makes them more suited to reptiles than amphibians, though the small size of most sites reduces their value. All three native terrestrial reptiles occur on calcareous grasslands that are part of a mosaic of suitable habitats.

4. Environmental, Economic & Social Importance of Biodiversity

Due to their floristic richness, calcareous grasslands tend to be attractive sites of high landscape value. One site (Kelhead) in Dumfries & Galloway is managed as a picnic area.

5. Factors affecting the Habitat

- There is **no current survey of the extent or importance** of this habitat in Dumfries & Galloway.
- **Under-grazing** and the complete cessation of management, especially at lowland sites, can result in reversion to rank grassland and eventually closed scrub and woodland.
- **Overgrazing** can result in the loss of tall herb and shrub species.
- **Agricultural intensification**, including fertiliser use, herbicide application, ploughing and re-seeding causes damage to calcareous grasslands.
- **Development**, particularly the in-filling of abandoned limestone quarries where grassland has re-established itself, can result in loss of habitat. For example, Eaglesfield lime pits were originally targeted for infill when the upgrading of the A74 was proposed; others were lost.
- Areas of calcareous grassland have been **planted with conifers**, especially those that appear as pockets within acidic grasslands.

6. Strategic Actions

6.1 Recent and current activity

- One site, at Kelhead Quarry, is currently designated as a **Local Wildlife Site**.

6.2 Other recommended actions

- Carry out a **survey** to determine extent and quality of this habitat type in Dumfries & Galloway.
- Raise awareness of the importance of this habitat with owners and encourage **appropriate management**, including possible grazing.

NEUTRAL GRASSLANDS

Priority Action (NG1)

Restore lowland neutral grasslands.
Target: Restore 5ha by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership/Regional Proposal Assessment Committee.

Priority Action (NG2)

Highlight the importance of lowland meadows to land managers and the public by including them in leaflets/panels and/or guided walks/talks.
Target: 10 publications/events by 2015.
Lead Partner: National Trust for Scotland.

Hay meadow at Rockcliffe. July 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics:

Semi-natural neutral (sometimes called mesotrophic) grasslands grow on well-drained fertile soil that is well balanced in nutrients. They are not heavily affected by agricultural improvement, such as extensive fertiliser use and re-seeding, and are usually managed as traditional hay meadows or pastures. They are often colourful landscape features in the summer, due to a high proportion of broad-leaved herbaceous species relative to grasses.

1.2 National and International Context

Many grasslands found on farms in the UK are now species poor and improved; grassland unaffected by agricultural improvement is rare and threatened; the majority of neutral grasslands are probably somewhere inbetween these two extremes. The total UK extent of unimproved species-rich neutral grassland is estimated to be less than 15,000ha, with less than 3,000ha in Scotland. There are less than 100ha in Dumfries & Galloway.

2. Dumfries & Galloway Status

2.1 Recent Trends

The importance of this habitat is now recognised and there is little or no deliberate conversion to more intensive uses. However, the traditional and sometimes labour intensive techniques required to manage them can be difficult to maintain, particularly with more erratic patterns of weather. As a result, neglect is often the greatest threat.

2.2 Current Distribution

Unimproved neutral grasslands are now restricted to occasional, often isolated, field edges where remnants of former hay meadows can be found. Areas such as steep banks, which cannot be intensively managed for agriculture, may contain remnant unimproved grassland, but these sites are vulnerable to scrub invasion. Small areas are also found on road verges and other urban sites.

2.3 Site Examples

The best example is found at **Lag Meadow** (SSSI) in Nithsdale, but even here the small size and ground conditions make hay cutting difficult.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with neutral grasslands, and the following action plans may also contain relevant information: Calcareous Grasslands, Acid Grasslands, Agriculturally Improved Grasslands.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Plants such as Yellow Rattle *Rhinanthus minor* and Meadow Cranesbill *Geranium pratense* indicate lack of agricultural improvement. Other typical plants include Black Knapweed *Centaurea nigra*, Pignut *Conopodium majus*, Crested Dog's-tail grass *Cynosurus cristatus*, Dyer's Greenweed *Genista tinctoria*, and several orchid species: Northern Marsh Orchid *Dactylorhiza purpurella*, Fragrant Orchid *Gymnadenia conopsea* and Common Twayblade *Listera ovata*. Locally scarce plants include Melancholy Thistle *Cirsium heterophyllum* and Upright Vetch *Vicia orobus* and Lesser Butterfly Orchid *Platanthera bifolia*. whilst Spignel *Meum athamanticum* may be locally common, but has a restricted UK distribution.

Crested Dog's-tail, a common grass of neutral grasslands. (Peter Norman)

3.2 Fungi and Lichens (high importance)

Species characteristic of unimproved grasslands include scarce species such as Pink Meadow Waxcap *Hygrocybe calyptriformis*. Genera with most or all of their species in grasslands include the waxcaps *Hygrocybe spp.*, pinkgills *Entoloma spp.,* earthtongues *Geoglossaceae* and *Dermoloma spp.*

Agricultural intensification has a more rapid and more drastic effect on fungi than on flora. Application of artificial fertilisers and liquid manure has been shown to eradicate many species within one year and all but a few others within five years. Once fertilised and improved for agriculture, such sites require at least 30 years to recover their grassland fungi. A few well-known species such as the Field Mushroom *Agaricus campestris* and the Giant Puffball *Calvatia gigantea* (which produces some of the largest fruitbodies of all British fungi reaching 70cm or more across) are able to withstand some fertilisation.

Common Green Grasshoppers create the sound of summer meadows. Langholm, July 2005. (Peter Norman)

3.3 Invertebrates (medium importance)

Management of grasslands as hay meadows is not ideal for many invertebrates as most larval foodplants are cut and removed all at once. However, species such as grasshoppers are able to exploit the short-term cover provided by the grasses and large numbers of pollen and nectar-feeding insects, such as bees, butterflies and hoverflies may visit during the flowering period. Earthworms occur at high densities and play a significant role in the ecology of neutral grasslands, mixing the soil, improving drainage and assisting in the decomposition of dead material.

3.4 Birds (low importance)

The demise of unimproved neutral grasslands is the principal reason for the almost total disappearance of Corncrakes *Crex crex* from the UK mainland. The last regular breeding in Dumfries & Galloway was in the 1980s. Today, Skylarks *Alauda arvensis* are the main nesting species, whilst Barn Owls *Tyto alba*, finches and other birds feed on the abundant small mammals, seeds or invertebrates associated with this habitat.

3.5 Mammals (low importance)

Field Voles *Microtus agrestis* may reach high densities during the summer. Hedgehogs *Erinaceus europaeus* and Moles *Talpa europaea* take advantage of the worm-rich soils.

4. Environmental, Economic & Social Importance of Biodiversity

- Most neutral meadows survive in a highly valued landscape of hedges and small woods, or in upland fringe landscapes with stone walls and moorland.

5. Factors affecting the Habitat

- **Commercial improvement** of pasture by drainage, ploughing, reseeding, and the application of inorganic fertilisers and herbicides has been shown to adversely affect floristic richness even at low levels of application.
- Increased **use of slurry**, which unlike traditional, occasional, light applications of farmyard manure and lime, is detrimental to floristic richness.
- The change from hay to **silage production** involves more frequent cutting, which reduces seeding opportunities for plants and disrupts the breeding of birds and other animals.
- The change from mowing to spring and summer **grazing** resulting in the loss of those meadow plants and animals which are intolerant to summer grazing and adapted to traditional cutting management.
- **Abandonment and neglect** results in gradual reversion to rank grassland dominated by False Oat-grass and eventually reversion to scrub or secondary woodland of lesser nature conservation value.
- Remaining sites are **small and highly fragmented**.

6. Strategic Actions

6.1 Recent and current activity

- Traditional hay meadow management is still practised on a few sites.

6.2 Other recommended actions

- Develop a fuller **understanding of restoration techniques** with the aim of expanding remnant patches of unimproved neutral grassland.
- **Train farmers** to recognise valuable grasslands on their farms and to link with management advisory services such as FWAG.
- Following an assessment of the likely impacts, **restore traditional management** techniques to sites where this is possible.
- Consider the feasibility of **creating new neutral grasslands** by reducing soil fertility and direct seeding of wildflowers.

Rattling ripe seed pods of Yellow Rattle once indicated harvest time. Kirkconnel, July 2007. (Greg Baillie)

ACID GRASSLANDS

Priority Action (AG1)

Restore lowland dry acid grasslands.
Target: Restore 6ha by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership/Regional Proposal Assessment Committee.

Priority Action (AG2)

Raise awareness of the importance of extensive areas of upland acid grassland, especially for birds, by including information on interpretation leaflets/panels and/or guided walks/talks.
Target: 10 interpretation leaflets/panels and/or guided walks/talks by 2015.
Lead Partner: RSPB.

Upland acid grasslands are typically extensive. Upper Nithsdale, June 2007. (Greg Baillie)

1. Habitat Description

1.1 Physical Characteristics:

Acid grasslands occur on soils with pH ranging from 4 to 5.5 derived from acid rocks such as sandstones, acid igneous rocks and on superficial deposits such as sands and gravels **Upland acid grassland**, which has low floristic diversity, is by far the most abundant type. It is usually managed as unenclosed rough grazing. **Lowland dry acid grassland** typically occurs below c300m on nutrient-poor, generally free-draining soils and is more likely to be enclosed than in the uplands, but is also normally managed as pasture.

Rock exposures and **springs and flushes** add considerably to the biodiversity of acid grasslands. They are the subject of separate action plans.

1.2 National and International Context

Acid grassland is probably one of the most extensive semi-natural habitats in Britain, yet little is known about its true extent or conservation management requirements, especially in the lowlands. Estimates suggest that there is in excess of 1,200,000ha of acid grassland in upland UK areas, with 743,000ha in Scotland. In the lowlands it is unlikely to exceed 30,000ha with only 5000ha in Scotland. The exact extent of acid grassland in Dumfries & Galloway is not currently known

2. Dumfries & Galloway Status

2.1 Recent Trends

Loss of acid grasslands to new afforestation has occurred at a much reduced level since the 1980s.

2.2 Current Distribution

Large expanses of uniform acid grassland are found throughout the uplands. Small patches of acid grassland are found less frequently in widely scattered lowland areas.

2.3 Site Examples

Extensive upland acid grassland examples include **Merrick-Kells Hills** (SAC/SSSI), **Moffat Hills** (SAC/SSSI) and **Cairnsmore of Fleet** (SSSI/NNR).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with acid grasslands, and the following action plans may also contain relevant information: Upland Springs and Flushes, Upland Heaths, Inland Rock Outcrops. In many cases, the presence of other habitats in a mosaic with acid grassland is critical to the overall biodiversity of an area.

3. Importance for Associated Species

3.1 Birds (very high importance)

The typical upland acid grassland birds are Skylarks *Alauda arvensis* and Wheatears *Oenanthe oenanthe,* the latter favouring areas with **rock exposures**. Ring Ouzels *Turdus torquatus* may also occur in rocky areas.

Several species of high conservation importance occur at low densities, but require extensive areas of the habitat in order to persist. Extensive sites form an important part of the territories of birds such as Golden Eagles *Aquila chrysaetos,* Red Kites *Milvus milvus,* Hen Harriers *Circus cyaneus,* Merlins *Falco columbarius* and Barn Owls *Tyto alba.* Breeding waders may include Curlews *Numenius arquata,* Lapwings *Vanellus vanellus,* Snipe *Gallinago gallinago and* rarely Golden Plovers *Pluvialis apricaria.* Black Grouse *Tetrao tetrix* also use the habitat where it is part of a mosaic with heathland, scrub and woodland.

Hen Harriers nest in heathland but hunt over extensive upland grasslands. (Steven Round)

3.2 Invertebrates (medium importance)

Acid grasslands are poorer than calcareous sites for invertebrates, though the difference is not as marked as for flowering plants. Recent work on invertebrate fauna of Dumfries & Galloway suggests that although diversity is low, a few species are locally or nationally rare. Scotch Argus butterflies *Erebia aethiops* are reasonably common in the region on lightly grazed or ungrazed acid grasslands, but they are known from only two sites south of the border. The larvae of Small Purple-barred moths *Phytometra viridaria* feed on Heath Milkwort and possibly Lousewort, and have been recorded on a few sites in the region.

3.3 Fungi and Lichens (high importance)

Unimproved, well-drained acid grasslands can be rich in fungi, including many species of waxcap *Hygrocybe*, *Entoloma* and *Dermoloma*.

Field Voles runs - more often seen than the animals themselves. Morton Loch, February 2007. (Peter Norman)

3.4 Mammals (medium importance)

Field Voles *Microtus agrestis* can occur in enormous numbers on acid grasslands, so long as they are not heavily grazed. Populations tend to cycle wildly over 3-5 years, which has a knock-on effect on the populations of predators.

3.5 Flowering Plants (medium importance)

Lowland sites can be species rich, but most of the uplands consists of species-poor swards. Grasses such as bents *Agrostis* spp., fescues *Festuca* spp., and Mat Grass *Nardus stricta* commonly occur, and Purple Moor Grass *Molinia caerulea* is abundant in wetter areas. Typical herbs include Tormentil *Potentilla erecta*, Heath Bedstraw *Galium saxatile*,

Tormentil, perhaps the most characteristic flower of acid grasslands. (Peter Norman)

Harebell *Campanula rotundifolia*, hawkweeds *Hieracium* spp., milkworts *Polygala* spp., and Eyebright *Euphrasia* spp. Plants such as Heath Spotted Orchid *Dactylorhiza maculata*, Mountain Pansy *Viola lutea*, and Green-ribbed Sedge form interesting assemblages in Dumfries & Galloway.

3.6 Reptiles and Amphibians (low importance)

Common Lizards *Zootoca vivipara* are associated with this habitat.

3.7 Non-flowering Plants (low importance)

Mosses and liverworts occur in low density in most acid grasslands, but interesting species can still sometimes be found in otherwise species poor swards. **Rock exposures** considerably add to the interest.

4. Environmental, Economic & Social Importance of Biodiversity

- The main hillwalking routes in Dumfries & Galloway pass principally through upland acid grasslands.
- Upland acid grasslands have often resulted from a degradation of heathland. Some are capable of restoration to this habitat, including commercial grouse moors. Once afforested or otherwise converted, restoration of such moors is very much more difficult or even impossible.

5. Factors affecting the Habitat

In the lowlands the habitat is affected by:

- **Agricultural intensification**, particularly fertilisation, ploughing and drainage.
- Lack of **grazing** leading to an invasion by coarse grasses and scrub.
- Change in agricultural production to **silage** production.

In the uplands the main causes of change are:

- **Inappropriate grazing** regimes (sheep, cattle, deer), typically excessive grazing at the wrong time of year.
- **Inappropriate muirburning** can lead to habitat deterioration and destroy the nests of ground nesting birds.
- **Inappropriate forestry** planting can threaten species of high conservation concern.
- **Abandonment and neglect** leading to encroachment by bracken.
- **Liming, ploughing and re-seeding** around the lower fringes of upland areas.
- **Windfarms** can result in direct loss of habitat through turbine bases and associated infrastructure.

6. Strategic Actions

6.1 Recent and current activity

- **RSPB** has identified upland areas that are important for birds, particularly those that are sensitive windfarm developments.

6.2 Other recommended actions

- From aerial photographs and previous survey work, **identify acid grasslands** in Dumfries & Galloway that are capable of restoration, either to high quality grasslands or other high biodiversity habitats.
- Ensure **minimal reduction in habitat** area due to other land uses such as forestry.
- Through restoration, aim to **link of fragmented remnants** of acid grasslands with each other and with other habitats.
- Promote appropriate management of acid grassland habitat through **advice to landowners.**
- Ensure that the progress made in implementation and other information relevant to the habitat is disseminated in existing **newsletters and circulars**.

INLAND ROCK OUTCROPS

Priority Action (IRO1)

Expand populations of rare and scarce species on inland rock outcrops.
Lead Partner: Scottish Natural Heritage.

Parsley Fern on scree slopes amongst Heather. Mennock Pass, August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Inland rock outcrops form a near-natural habitat. Variation is related to aspect, altitude, soil conditions, but especially rock type. **Rock faces** support only species capable of survival in a hostile environment, but **rock ledges**, particularly those in the uplands with base-rich substrates that are inaccessible to grazing, are extremely valuable for a range of species. **Upland seepages** not only add moisture to rock faces and ledges but tend to be relatively nutrient rich in comparison to the surrounding land because they have accumulated nutrients leached down through the bedrock. Base-rich seepages are especially valuable.

Screes occur where weathered rock falls onto adjacent slopes. The rocks are usually angular but can range from small stones through to boulders and large blocks. Screes made of smaller stones tend to be more mobile, but even large blocks may be slowly moving downslope. They are generally well-drained habitats but, as they occur in areas of high rainfall, drought is rarely a problem. However, nutrients are also carried down the slope with the water.

Natural **caves** provide unique environments. Shallow caves and cave entrances possess many similar qualities and species to the exterior rock that surrounds them, but the deeper the cave goes, the greater the change becomes. Light levels drop sharply and temperature and humidity levels become much more stable, which allows a small but highly specialised fauna to exist.

1.2 National and International Context

This habitat occurs widely across Europe, but is very localised in distribution, predominantly in upland areas. Due to the fragmented nature of this habitat and its often near vertical structure, an accurate assessment of its extent, both nationally and locally, is almost impossible to achieve.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has been little recent change to inland rock outcrops.

2.2 Current Distribution

Due to the nature of the geology, most natural inland rock outcrops occur in the uplands in the north of the region. Also the geology means that there are few deep natural caves that are large enough to be explored by people.

2.3 Site Examples

Granite outcrops include the **Dungeon Hills**, **Craignaw**, and **Clints of Dromore and Spout o' the Clints** (SSSI/NNR). Other notable rock outcrops include **Cairnbaber** (SSSI) **Glenwhargen Craig**, and several sites in the **Moffat Hills** (SSSI). **Crichope Linn** contains important sandstone outcrops.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with inland rock outcrops, and the following action plans may also contain relevant information: Upland Springs and Flushes, Coastal Cliffs and Slopes, Quarries and Mineral Workings.

3. Importance for Associated Species

3.1 Flowering Plants (very high importance)

Vegetation of inland rock outcrops is characteristically

discontinuous and sparse. Typical species of upland rock **ledges** include Great Woodrush *Luzula sylvatica,* Wood Crane's-bill *Geranium sylvaticum,* Water Avens *Geum rivale* and Wild Angelica *Angelica sylvestris.* Juniper *Juniperus communis,* Aspen *Populus tremula* and Rowan *Sorbus aucuparia* may also become established on these ledges, and even in narrow cracks on vertical **rock faces**, though the latter is generally poor for flowering plants.

Botanists have long recognised the outstanding importance of upland rock **ledges** as a habitat for a diversity of nationally rare and scarce plants. They are of particular importance where water from **upland seepages** trickles over rocks. The following species are mostly confined to the Scottish Highlands, with only small populations in the Lake District, the Pennines, North Wales and at a few locations in Dumfries & Galloway: Alpine Cinquefoil *Potentilla crantzii,* Alpine Sawwort *Saussurea alpina,* an eyebright *Euphrasia frigida*, Black Alpine Sedge *Carex atrata*, Hair Sedge *Carex capillaris*, a lady's mantle *Alchemilla wichurae,* Purple Saxifrage *Saxifraga oppositifolia,* Roseroot *Sedum rosea,* Mountain Sorrel *Oxyria digyna* and Alpine Meadow-rue *Thalictrum alpinum.*

Screes colonise with flowering plants only very slowly, if at all. However, plants of more stable screes include Bell Heather *Erica cinerea* and Heath Bedstraw *Galium saxatile*. A few screes, such as in Scaur Glen, have been colonised by Hazel *Corylus avellana* and other scrub species.

3.2 Non-flowering Plants (very high importance)

Oblong Woodsia *Woodsia ilvensis* is one of Britain's rarest ferns, and was reduced almost to extinction by Victorian collectors in the Moffat Hills. It has subsequently been reintroduced, but remains highly threatened. Holly Fern *Polystichum lonchitis* also occurs on base-rich rock **ledges** and crevices in the Moffat Hills, its only site in the south of Scotland.

Inland rock ledges and outcrops are also important for mosses and liverworts. The typical habitat of Narrow-leaved Fringe-moss *Racomitrium aquaticum* is vertical siliceous **rock faces** on exposed or shaded mountain crags or in gorges, whilst Upright Brown Grimmia *Schistidium strictum* is a moss of exposed rock faces on upland crags. It is scarce south of the Highlands. Toothed Pouncewort *Drepanolejeunea hamatifolia* is a liverwort with a very limited global distribution, but has been recorded on crags near Loch Dungeon. Sandstone has good moisture holding capacity and can therefore be rich in mosses and liverworts.

Mobile **screes** are poor for ferns and bryophytes, with Parsley Fern *Cryptogramma crispa* and Woolly-fringe Moss *Racomitrium languginosum* being the most obvious species. However, more stable screes composed of larger stones, and especially block screes, support many species in moist nooks and crannies that are similar to those found in woodland.

3.3 Birds (very high importance)

Several birds of prey use **rock ledges** as nesting sites, especially Golden Eagles *Aquila chrysaetos*, Peregrines *Falco peregrinus*, Kestrels *Falco tinnunculus* and occasionally Buzzards *Buteo buteo* and Merlins *Falco columbarius*. Many of the same rock faces are used by nesting Ravens *Corvus corax*.

Peregrine. (Laurie Campbell)

Ring Ouzels *Turdus torquatus* have declined rapidly in Dumfries & Galloway, with just a few pairs now breeding in the east of the region. They particularly favour crags, gullies, **screes** and boulder fields, especially those overhung with heather and scattered trees. Wheatears *Oenanthe oenanthe* are also typical of scree slopes.

3.4 Invertebrates (medium importance)

In **upland seepages** where shallow trickles or films of water run over rock exposures, the rock surface will generally have an algal film growing on it, and this forms the base of the food chain for a small, but exceptionally specialised invertebrate assemblage. There may also be a scattering of other plants, especially mosses and liverworts that are inhabited by some of the invertebrates that constitute this assemblage.

Red Carpet moths *Xanthorhoe decoloraria* are known from only a few sites in the region, but are probably common wherever Lady's-mantle, the larval foodplant, occurs on exposed rocks in moorland. **Cave** life is largely unexplored in the region but at least 35 species of UK invertebrate are known to be restricted to such habitats.

3.5 Reptiles and Amphibians (medium importance)

Although inland **rock ledges** and outcrops may appear inaccessible to reptiles, Adders *Vipera berus* and Common Lizards *Zootoca vivipara* do manage to find their way onto these sites and south facing ledges and outcrops form ideal basking sites. Holes under rocks and **screes**, and narrow **caves** may also be used as hibernacula.

3.6 Mammals (medium importance)

Much of the biodiversity of **rock ledges** and outcrops results from the fact that they are free from mammalian grazers and predators. However, where **caves** occur, particularly deeper ones, they can be very important roosting and hibernation sites for bats.

3.7 Fungi and Lichens (medium importance)

Inland rock outcrops support many lichens but, unlike flowering plants, they are not susceptible to grazing. Therefore, the type of rock and its location/ aspect is more important than its accessibility to grazing animals, and rare species are not confined to inaccessible ledges and faces. Rocks on **scree** slopes may be subject to frequent movement, making lichen establishment more difficult.

Cudbear lichen Ochrolechia tartarea. (Peter Norman)

4. Environmental, Economic & Social Importance of Biodiversity

Inland rock outcrops add considerably to the landscape, often forming the most dramatic feature of an area.

5. Factors affecting the Habitat

- **Rock climbing** can accidentally disturb nesting birds or damage flora. Some birds, and occasionally plants, are subject to deliberate illegal disturbance and theft.
- **Stone removal** for agricultural or recreational purposes such as track/path building could damage biodiversity and geological features. However, there is no evidence that historical stone removal for drystone dyking has had a major impact.
- Some livestock and especially **feral goats** are agile enough to reach inland rock outcrops not accessible to other herbivores. They may therefore restrict the distribution of some plants in the Moffat and Galloway Hills.
- Agricultural practices such as **grazing, fertiliser and herbicide treatment**, and stock feeding can seriously damage the biodiversity of inland rock outcrops. Bracken spraying needs to be carefully planned to avoid damage to scree communities.

6. Strategic Actions

6.1 Recent and current activity

- An action programme is underway for the restoration of Oblong Woodsia populations co-ordinated by **Royal Botanic Garden Edinburgh**.
- Monitoring of Ravens, Peregrines and other crag nesting birds of prey is carried out by the **Dumfries & Galloway Raptor Study Group.** Sites prone to disturbance receive special protection.
- The **National Trust for Scotland** relays live CCTV images of nesting Peregrines to its visitor centre at Grey Mare's Tail.
- The **Mountaineering Council of Scotland** has produced an information sheet about birds and climbing, which contains guidance on responsible climbing.

6.2 Other recommended actions

- Examine **grazing levels** in key locations to assess whether modifications to rates and timing and/or use of exclosures might lead to an expansion of rock ledge communities.
- Negotiate **reasonable access restrictions** with climbing organisations on specific sites at specific times of year where recreational disturbance is known to be a problem.
- Ensure that all new **cycle and footpaths avoid disturbance to important areas** for breeding birds.

MONTANE MOSS-HEATHS

Priority Action (MMH1)

Reduce grazing pressure on montane moss-heaths where this is considered necessary.
Lead Partner: Scottish Natural Heritage/Forestry Commission Scotland/National Trust for Scotland.

1. Habitat Description

1.1 Physical Characteristics

Montane Moss-heaths are found in areas above the natural level of tree growth where conditions approach most closely to those of Arctic regions. This is around 600m above sea level throughout much of the uplands of Scotland, though can occur at lower altitudes where an oceanic climate produces exceptionally cool, cloudy summers and frequent strong winds. In these areas grass and heather give way to habitats dominated by mosses, club-mosses and lichens. Carpets of **moss-heath**, dominated by Woolly-Fringe Moss, are frequent.

Woolly-fringe Moss cannot tolerate prolonged deep snow cover. Hollows where snow accumulates and lies for long periods support an even more specialist **snow-bed** habitat of grasses, sedges, mosses and liverworts. Sparsely vegetated **stony areas and rocks** are also common on montane heaths.

1.2 National and International Context

Montane moss-heaths have a restricted European distribution, but occur extensively in Norway, Iceland, Greenland, Russia and Canada. Over 90% of the 600,000ha of montane habitat in the UK are in Scotland, mostly in the Highlands, especially the Cairngorm Mountains. The area of montane moss-heath in Dumfries & Galloway is not accurately known. Little of the land above 600m supports montane heath vegetation, probably less than 100ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

The small remaining areas of montane moss-heath have continued to be adversely affected by grazing pressure, with added recent pressures from hill-walking, mountain-biking, quad/trail bikes, potential infrastructure developments and climate change.

2.2 Current Distribution

This habitat is limited to small areas on the highest hills of Dumfries & Galloway, mostly in the Moffat, Carsphairn and Galloway ranges. There are few long-lying snow-beds in the region. In areas where winter snow accumulates, although the vegetation may be modified, only rarely does it approach the species composition of the specialist communities found further north.

2.3 Site Examples

The Merrick-Kells and Moffat ranges hold some of the best developed and largest areas of montane moss-heath south of the Highlands. Good examples are found on **Corserine** (SAC/SSSI) and **White Coomb** (SAC/SSSI). Other examples occur on **Beninner, Moorbroch, Cairnsmore of Carsphairn, Cairnsmore of Fleet** (NNR and SSSI) and **Lamachan**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with montane moss-heaths, and the following action plans may also contain relevant information: Acid Grasslands, Upland Heaths, Montane Scrub, Upland Springs and Flushes, Inland Rock Outcrops.

Woolly Fringe-moss Racomitrium lanuginosum. White Coomb, July 2007. (Peter Norman)

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Late-lying **snow-beds** and **moss-heaths** have characteristic bryophyte communities. Woolly-Fringe Moss *Racomitrium languginosum* is well adapted to montane conditions, deriving all its nutrients from rain and mist and able to withstand total drought for up to a year. Other moss heath species, though not restricted to this habitat, include Broom Fork Moss *Dicranum scoparium,* Little Shaggy-moss *Rhytidiadelphus loreus,* Glittering Wood-moss *Hylocomium splendens,* Red-stemmed Feather-moss *Pleurozium schreberi* and Fir Clubmoss *Huperzia selago*. The rare *Splachnum vasculosum,* recorded in the Galloway Hills in 1957 and 1985 is sometimes associated with such conditions. Liverworts include Alpine Rustwort *Marsupella alpina* and Notched Rustwort *M. emarginata.*

3.2 Fungi and Lichens (high importance)

A diverse range of lichens is associated with montane heath including Reindeer 'Moss' *Cladonia arbuscula* and Iceland 'Moss' *Cetraria islandica*. Fungi associated with snow-melt are known from the Alps and have recently been discovered in the Scottish Highlands and the Lake District. Some may also occur in Dumfries & Galloway.

3.3 Invertebrates (high importance)

Despite the hostile environment, a number of invertebrates specialise in moss-heath habitats, although few are totally restricted to this habitat: A money spider *Hilaira frigida* is found beneath **rocks** on the summits of mountains, a nationally scarce fly *Alliopsis atronitens* is found in **moss-heath** and **snow-bed** communities in the Moffat Hills, and a ground beetle *Carabus glabratus* is an exclusively montane species. The nationally rare Broad-bordered White Underwing moth *Anarta melanopa,* a day-flying species recorded from **moss-heath** on the Moffat and Galloway Hills, is known from just one site south of Dumfries & Galloway.

3.4 Flowering Plants (medium importance)

Though montane heaths have a low diversity of flowering plants a number of important species occur. Species present include Wavy Hair-grass *Deschampsia flexuosa* Stiff Sedge *Carex bigelowii*, Dwarf Willow *Salix herbacea,* Heath Bedstraw *Galium saxatile* and Mountain Crowberry *Empetrum nigrum* subsp. *hermaphroditum*.

3.5 Birds (medium importance)

Few birds breed in this hostile environment. Dotterels *Charadrius morinellus* have occasionally been found breeding, but are easily overlooked and most likely to be seen on their spring migration; Golden Plovers *Pluvialis apricaria* also breed in such habitats though elsewhere in the UK are more common on lower moorlands; Snow Buntings *Plectrophenax nivalis* are scarce non-breeding visitors. Perhaps only the occasional Skylark *Alauda arvensis,* Meadow Pipit *Anthus pratensis* and Wheatear *Oenanthe oenanthe* are regular breeders. Other birds, such as Golden Eagles *Aquila chrysaetos* and Merlins *Falco columbarius* visit montane heaths to hunt and swifts often feed low above montane heath.

3.6 Reptiles and Amphibians (low importance)

Remarkably, Common Frogs *Rana temporaria* on montane heaths are not uncommon. However, the habitat is generally of low importance for reptiles and amphibians.

Common Frog, (Paul McLaughlin)

3.7 Mammals (low importance)

Mountain Hares *Lepus timidus* occasionally feed on montane heaths.

4. Environmental, Economic & Social Importance of Biodiversity

Monitoring of montane heath may provide a good indicator of climate change.

5. Factors affecting the Habitat

Poor soils and extreme climate render montane heath unsuitable for forestry or intensive agriculture. However, the shallow soils, the restricted growing season, and the fragmented distribution render montane areas especially vulnerable to:

- **Overgrazing** by sheep, goats and deer which has caused the loss of much montane heath by conversion to grazing-tolerant grasses. Heavy grazing may also result in **nutrient enrichment** and **physical uprooting** of plants.
- Increasing **recreational pressure** from walkers and mountain bikes causing damage to the fragile vegetation and soils.
- **Quad bikes,** even a single journey, can cause significant damage.
- **Fires** spreading from the sub-montane zone causing destruction of soils and vegetation.
- The long-term effects of pollution such as **acidification** and global warming may result in the loss of species that will be unable to recolonise.
- **Developments** such as radio masts and wind farms have the potential to cause substantial damage.
- **Climate change** has the potential to totally wipe out this habitat in Dumfries & Galloway; a process that may already be underway.

6. Strategic Actions

6.1 Recent and current activity

- Monitoring of the impact of hill-walking and grazing on montane heath at White Coomb by the **National Trust for Scotland**.
- A PhD study entitled 'Assessing the potential for recovery of degraded montane heaths" was begun in 2006, funded by SNH and supervised by **Aberdeen University, SNH, Macaulay Land Use Research Institute** and the **Centre for Ecology & Hydrology**. It will assess the current condition of UK montane heath and whether a decrease in grazing will allow successful recovery of degraded heaths.

6.2 Other recommended actions

- Carry out **surveys** to identify areas of near natural montane communities.
- **Protect from inappropriate development**.
- **Discourage disturbance** and damage from inappropriate forms and levels of use, including vehicles and recreational pressure.
- Ensure that **Galloway Military Training Area excludes vulnerable zones and times**.
- Ensure that organised events (e.g. mountain marathon, orienteering etc.) consult with relevant organisations to **minimise damage to vulnerable zones**.
- Consider the need for studies to **investigate the effects of acid deposition** on montane communities.

Fir Clubmoss. White Coomb, Moffat Hills, May 2007. (Peter Norman)

UPLAND HEATHS

Priority Action (UH1)

Restore an extensive area of upland heath for biodiversity.
Target: Restore 3000ha by 2017.
Lead Partner: Langholm Moorland Demonstration Project/Regional Proposal Assessment Committee.

Managed heather mosaic. Mennock Pass, August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Upland heaths are characterised by the presence of dwarf shrubs on nutrient poor mineral soils, peaty podsols or shallow peat (less that 0.5m deep). Heath vegetation on deep peat is generally regarded as bog.

Upland heaths are found below the montane zone but above the upper edge of enclosed agricultural land. For much of Britain this is between 300m and 600m above sea level, though descending to near sea level in northern Scotland. Heathland is usually found in areas with over 100cm of precipitation a year and it is often part of a mosaic of habitats with blanket bog, grassland, scrub, woodland and rock habitats.

The variation in the vegetation communities of upland heaths is broadly linked to climate, but is also influenced by factors such as geology, altitude, aspect, slope, maritime influences and management practices (including grazing pressure and burning regime). **Dry heaths** occur on freely draining acid to neutral soils. Typical shrub species include Heather, Blaeberry, Crowberry and Bell Heather. **Wet heaths** are more commonly found in the north and west where the climate is damper. Here typical plant species are Cross-leaved Heath, Heather, Deer Grass and Purple Moor Grass, with a carpet of mosses including *Sphagnum* species.

1.2 National and International Context

Upland dwarf-shrub heaths have international conservation significance and are largely confined to the British Isles and the western seaboard of Europe. There is approximately 3.7 million hectares of upland heath habitat in the UK, 2,514,000ha of it in Scotland. This is land with at least 25% heather cover, but 1.6 million hectares of it is estimated to have less than 50% heather dominance. An estimated 100,000ha of upland heathland is found in Dumfries & Galloway. This includes the most extensive area of upland wet heath in the UK south of the Highlands.

2. Dumfries & Galloway Status

2.1 Recent Trends

Although loses to forestry have declined in recent years, areas of upland heathland have continued to be replaced with grassland, due to loss of heather cover.

2.2 Current Distribution

Heathland is found throughout the Southern Uplands, but due to geology, climate and land-use history the best quality and most extensive areas are located in the east of the region.

2.3 Site Examples

Good examples of upland heath are to be found on the **Lowther Hills** (SPA/SSSI), with extensive

areas also on the **Langholm Hills** (SPA/SSSI). Further west, the heaths tend to be wetter and more fragmented, generally with less Heather cover. **Merrick-Kells Hills** (SAC/SSSI) includes many sites, such as on Corserine, but the most extensive upland heath in west is on **Glen App and Galloway Moors** (SPA/SSSI). Smaller areas are found at many other locations, such as **Cairnsmore of Fleet** (SSSI/NNR), **Laughenghie and Airie Hills** (SSSI), **Artfield Fell**, **Criffel** and **Glenquicken Moor**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with upland heaths, and the following action plans may also contain relevant information: Acid Grasslands, Blanket Bogs, Inland Rock Outcrops.

3. Importance for Associated Species

3.1 Birds (very high importance)

Upland heaths are prime habitats for a suite of breeding birds including Red Grouse *Lagopus lagopus*, Black Grouse *Tetrao tetrix*, Golden Plovers *Pluvialis apricaria*, Dunlins *Calidris alpina*, Snipe *Gallinago gallinago*, Hen Harriers *Circus cyaneus*, Merlins *Falco columbarius*, Wheatears *Oenanthe oenenthe*, Ring Ouzels *Turdus torquatus* and Twites *Carduelis flavirostris*. Most of these have declined substantially over the last 100 years, and some, such as Dunlins and Ring Ouzels, are now very rare upland heathland breeding species. Wide-ranging species such as Golden Eagles *Aquila chrysaetos* hunt over upland heaths.

3.2 Non-flowering Plants (medium importance)

The moss and liverwort community of upland heaths is strongly influenced by the stage of the heather. Many species are abundant during the pioneer phase of heather growth. For example, Compact Bog-moss *Sphagnum compactum*, a moss of **wet heaths**, is a poor competitor and usually found in open vegetation with bare ground. Some mosses have been shown to aid heather regeneration, but they decline as the heather matures, only returning as the heather begins to degenerate and gaps open in the canopy. However, at this stage they have to compete with flowering plants. Light burning can be beneficial for bryophytes, allowing the pioneer phase to begin again, but intensive burning can be very damaging, wiping out some species.

Most bryophytes of upland heaths are common species, but in the north west Highlands several species of liverwort of restricted world distribution form luxuriant mats under the heather canopy. A few of these have been recorded in Dumfries & Galloway, on Cairnsmore of Fleet and other sites. They include Lesser Whipwort *Bazzania tricrenata* and Purple Spoonwort *Pleurozia purpurea*.

Northern Eggar Moths, abundant over upland heaths in some years. Grey Mare's Tail, July 1993. (Peter Norman)

3.3 Invertebrates (high importance)

Many invertebrates are dependent on the three-dimensional structure of upland shrubs and other vegetation. Insects such as craneflies *Tipulidae* form a major part of the diet of the chicks of many moorland birds, including the Red grouse. The larvae of a large number of moths feed on Heather and Blaeberry, including Emperor Moth *Saturnia pavonia* and Northern Eggar *Lasiocampa quercus.* Sword-grass *Xylena exsoleta* is also known from moorland, as well as open woodland, though its larval foodplant is not known.

A number of uncommon species have been recorded from heaths in the region, such as the nationally scarce spider *Clubiona norvegica* on wet moorlands; a nationally scarce ground beetle *Carabus nitens* on wet upland heaths with *Sphagnum;* and a rare bee *Nomada roberjeotiana* at its only Scottish sites.

3.4 Flowering Plants (high importance)

In addition to Heather *Calluna vulgaris*, upland heaths in Dumfries & Galloway are characterised by plants such as Crowberry *Empetrum nigrum*, Blaeberry *Vaccinium myrtillus*, Mat Grass *Nardus stricta*, Red Fescue *Festuca rubra* and Sheep's Fescue *Festuca ovina*. Where they are derived from former woodland, the Heather may provide a refuge for many of the associated species of the original woodland ground layer.

Less common upland heath species in Dumfries & Galloway include Cloudberry *Rubus chamaemorus* and Lesser Twayblade orchid *Listera cordata* growing amongst or beneath Heather and Blaeberry on **wet heaths**, and Bearberry *Arctostaphylos uva-ursi,* a low shrub found on **dry heaths** over gravely or rocky ground. Dwarf Cornel *Cornus suecica,* occurs in Scotland south of the Highlands in only in a few small areas of the Moffat Hills.

3.5 Fungi and Lichens (high importance)

Some areas of upland heathland are very rich in lichen communities, including a covering of *Cladonia* species.

3.6 Reptiles and Amphibians (high importance)

Adders *Vipera berus* are the typical upland heathland reptile, but Common Lizards *Zootoca vivipara* and amphibians such as Common Frogs *Rana temporaria* also occur.

3.7 Mammals (high importance)

Mountain Hares *Lepus timidus* are charcteristic members of the upland heath community, but there is evidence of local declines. Other mammals, such as Red Deer *Cervus elaphus,* also make use of this habitat.

Mountain Hare in winter. (Laurie Campbell)

4. Environmental, Economic & Social Importance of Biodiversity

- Most upland heaths are managed as extensive grazing for livestock, and/or as grouse moors that are dependent on Heather and its associated plants and invertebrates.
- Extensive upland heaths dominate the landscapes where they occur, particularly during flowering in late summer and autumn.
- Though there is a historic tradition of collecting moorland berries, this is currently limited to a few parts of the Highlands. In Finland, an estimated 67% of the population pick these resources; in Sweden it is the basis of a significant rural business; whilst in Norway the health authorities are so convinced of the benefits that they have produced maps of good berry-picking areas.

5. Factors affecting the Habitat

- **Overgrazing** of sheep and Red Deer, especially on newly burnt areas, is incompatible with maintaining upland heather cover and diversity.
- **Heather Beetles** may be increasing, along with the frequency of beetle outbreaks. It is believed that heather beetle is more likely to kill old heather or heather that has been stressed by drought, heavy grazing, trampling etc.
- **Poorly managed muirburn** causing simplification of vegetation structure, loss of lower plant assemblages and erosion of peat.
- **Conversion to more intensive forms of agriculture**, through drainage of wet heath and moorland 'gripping', ploughing, reseeding, liming and fertilisation, particularly at lower elevations.
- **Encroachment of bracken** reduces the biodiversity value of the habitat.
- Replacement of heathland with **forestry** has taken place in the past, but is now controlled by national forestry policy.
- The **development** of wind farms and associated access tracks is an increasing threat.
- **Hillwalkers and mountain bikes** can cause localised erosion.
- **Acidification** from atmospheric deposition may lead to habitat degradation.

- **Heath Star Moss** *Campylopus introflexus*, an introduced species from the southern hemisphere first discovered in Britain in 1941, has spread rapidly over heathland throughout the country and threatens native mosses and liverworts.

6. Strategic Actions

6.1 Recent and current activity

- The Linking the Ling Project, led by the **Heather Trust** has worked with landowners on demonstration sites in Nithsdale, and uses these to promote good management practice.
- The Black Grouse Recovery Project, led by **RSPB**, has heathland restoration and enhancement as an important prescription for key Black Grouse leks. Work undertaken in both Galloway and Nithsdale on upland heaths.
- **SNH**'s Moorland Management Scheme provided funding for the management of designated sites. This is now incorporated into the Scottish Rural Development Programme.
- The Langholm Moor Demonstration Project, an ambitious and innovative 10-year moorland restoration project that aims to integrate grouse, raptors, biodiversity and other land use interests was begun in 2007. It is supported by **The Buccleuch Group, SNH, The Game and Wildlife Conservation Trust, RSPB** and **Natural England.**

6.2 Other recommended actions

- **Restore, extend and enhance** upland heaths as part of upland mosaics and transitions of semi-natural and natural habitats appropriate to soils and climate. An upland heathland mosaic with grassland, scrub, flower-rich areas, boggy pools, *Sphagnum* lawns, flushes, wet peat and seepages will benefit a wide range of invertebrates and birds. Maintain as much structural diversity as possible.
- Identify opportunities for restoration in **Forest Design Plans** and restocking proposals.
- Encourage measures that **reverse habitat fragmentation**.
- Use **demonstration sites** to provide advice on best management and restoration practices for upland heaths. Promote advice on good muirburn practices.
- **Encourage studies** to investigate the effects of acid deposition.
- **Minimise disturbance** from activities such as off-road cycling or use of motor bikes or 4-wheel drive vehicles, especially at fragile higher altitude sites. A small amount of localised ground disturbance is beneficial to some species.
- **Raise public awareness** of upland heathland through guided walks, talks, publications, press releases, and environmental education opportunities.
- **Raise landowner awareness** of the importance of upland heathland.

Heather provides nectar for many bees, hover-flies and in this case a robber-fly. Wanlockhead, August 2007. (Peter Norman)

NATIVE WOODS

There are separate Habitat Action Plans for all the main types of native woodland in Dumfries & Galloway: wet woods, oak woods, Ash woods, birch woods, and scrub woods. In reality, most woods are composed of mixed broadleaved trees and stands of all woodland types can occur in close proximity and intergrade with each other. Oaks are common in many local woods, especially on sloping ground, but often with birches on the higher ground and Ash at the base of the slope. The following information applies to all woodland types, and should be read in conjunction with the individual Habitat Action Plans.

1. Habitat Description

1.1 Physical Characteristics

Native tree and shrub species are those that formed the original natural woodland cover of an area before the influence of man. Although all woods in the UK have been modified by people, native woods are those that are still composed predominantly of native species of trees and shrubs. These woods are of greatest value for biodiversity because the wildlife associated with them has evolved with them over many centuries, sometimes becoming highly adapted and highly dependent on this habitat. Although trees such as Norway Spruce and Silver Fir occurred naturally in Britain prior to the last ice age, they are not considered native as they have not evolved with native British wildlife over the last 10,000 years.

Semi-natural woods are those that have grown up from natural regeneration or vegetative regrowth; they have not been planted by man. However, semi-natural native woods are much more than simply groups of trees. The soils, bacteria, fungi, plants and animals are as much a part of woodland as the trees, and it is possible for woods to survive temporarily, as many have demonstrated during their history, without any standing trees.

From a biodiversity perspective, **ancient woods** are the most important type of native wood. These woods grow on sites that have been continuously wooded for many centuries, and are therefore most likely to support specialised woodland species. In England, woods are considered to be ancient if they can be traced back to at least 1600. In Scotland, documentary evidence dating this far back is rarely available, so all present day woods that were also shown on General Roy's Military Survey of Scotland (1747-1755) and the First series of Ordnance Survey (c1860), are considered to be ancient. However, the best way of assessing the age of a wood is through local ecological, archaeological and historical research.

Most woods consist of a ground layer of leaf litter, mosses and other plants; a field layer of wild flowers and ferns; a shrub layer or understorey of low growing woody shrubs such as Hazel and Hawthorn; and a canopy of tree boughs and leaves. In some woods one or more of the layers may not be well developed. In upland woods, for example, the ground layer is often well developed but the field layer and understorey is frequently poorly represented.

Within native woods, there are a number of sub-habitats, which although small in extent, are often valuable for biodiversity: Open areas associated with **rock outcrops** are integral parts of these woods and make a vital contribution to their ecological diversity; **woodland ponds** created in the hollows left by upturned rootplates are some of the most natural ponds in Britain; and **ground-water seepages** are often more alkaline and contain plants and invertebrates that are rare in the main part of the wood.

Decaying wood, both standing and fallen, is an important natural component of all native woods, though a history of removal means that it is not common in most modern woods.

1.2 National and International Context

Native woods currently account for only around 2% of the land cover of Scotland. The full extent and quality of semi-natural native woods in Dumfries & Galloway is not accurately known. There is thought to be about 12,000ha of broadleaved woodland (less than 2% of the region) of which 5,000ha is semi-natural. Forestry Commission Scotland owns and manages approximately 2,500ha of broadleaved woodland, but most of this is unlikely to be semi-natural, and 60% of it is identified only as 'Mixed Broadleaves'. (See Broadleaved and Mixed Plantations Action Plan).

2. Dumfries & Galloway Status

2.1 Recent Trends

Since the Forestry Commission's review of policy for broadleaves in 1985, the conservation and management of native woods has become more important. In recent years approximately 200ha of new broadleaf planting has taken place annually together with 150ha of restocking, mainly as broadleaf element within commercial woodlands.

2.2 Current Distribution

Dumfries & Galloway's native woods are concentrated in the main river valleys, especially the Cree, Fleet, Dee/Ken and Nith.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

Most trees are dependent on mycorrhizal associations with fungi, so it is no surprise that fungi attain their greatest diversity in woodland. They also play an essential role in the decomposition of plant litter and in nutrient recycling. Though fungi are widely distributed in all native woods, some species that are restricted to particular types. A number of rare fungi have been recorded in the native woods of Dumfries & Galloway, including *Rimbachia bryophila* recorded on moss in Carstramon Wood in 1993. However, few mycological surveys have been undertaken and a number of other species probably await discovery.

Chanterelle Cantharellus cibarius, one of the best known woodland mushrooms. Holy Linn, September 2006. (Peter Norman)

3.2 Non-flowering Plants (very high importance)

Ferns are often abundant in native woods, notably Hard Fern *Blechnum spicant*, Male Fern *Dryopteris filix-mas* Lady Fern *Athyrium filix-femina* and Common Polypody *Polypodium vulgare*. Wilson's Filmy Fern *Hymenophyllum wilsonii* is rare, restricted to shaded woodland, often in ravines/cleughs, a similar habitat to Hay-scented Buckler fern *Dryopteris aemula*, found in Carstramon Wood. There is also a wide range of mosses and liverworts in the region's native woods.

3.3 Flowering Plants (very high importance)

The **field layer** of native woods typically flowers in spring, before the canopy comes into full leaf and restricts light levels. Ungrazed and lightly grazed native woods are particularly notable for Bluebells *Hyacinthoides non-scripta*, which occur in a profusion seldom encountered beyond the British Isles. Wood Anemone *Anemone nemorosa,* Dog's Mercury *Mercurialis perennis* and Wild Garlic *Allium ursinum* can also grow in profusion depending on local conditions. Though such species are widespread and common, they are an important component of native woods and require conservation. A few less common species also occur, including Early Dog Violet *Viola reichenbachiana* at some of its few Scottish localities.

Distinctive flush vegetation dominates **woodland seepages** with Opposite-leaved Golden Saxifrage *Chrysosplenium oppositifolium* typical in Dumfries & Galloway. The **understorey** is not noted for a high diversity of flowering plants, but a few grow on the **trees** themselves, including Atlantic Ivy *Hedera helix* subsp. *hibernica,* native in Scotland only in the south west.

3.4 Invertebrates (very high importance)

Native, especially ancient, woods have the richest invertebrate fauna of any habitat in Dumfries & Galloway. Due to the long history of woodland exploitation many species have extremely restricted distributions and some are very rare indeed.

Invertebrate species that rely on **decaying wood** are now some of the most threatened in Britain. More than 700 species of flies and a similar number of beetles are dependant to some extent on deadwood in the UK. For example, in Dumfries & Galloway the hoverfly *Criorhina floccosa* is found in wet rotting Wych Elm, Sycamore and Beech; the larvae of a nationally scarce soldier beetle *Malthodes guttifer* develops in decaying wood; fungal and epiphytic growth on both sound and decaying timber provides a habitat for invertebrates such as fungus gnats; and fallen dead wood on the ground provides shelter and overwintering sites for adult ground beetles and woodlice, as well as essential habitat for the developing larvae of saproxylic invertebrates such as many rove and longhorn beetles. Fallen dead wood

on groundwater seepages and in streams supports a varied fauna of flies, including the nationally rare *Lipsothrix errans* cranefly.

Woodland seepages are extremely important for a very large number of specialist invertebrates. Although of only moderate pH, the water in seepages is sufficiently rich in calcium to support diverse communities of molluscs, found amongst the vegetation and in saturated leaf litter.

Buzzard (Paul McLaughlin)

3.5 Birds (very high importance)

Lowland native woods support possibly a greater diversity of bird species than any other habitat, although few, if any, are restricted to this habitat. Typical species include Chiffchaffs *Phylloscopus collybita,* Sparrowhawks *Accipiter nisus,* Buzzards *Buteo buteo,* Tawny Owls *Strix aluco* and Green Woodpeckers *Picus viridis.*

3.6 Mammals (very high importance)

Most British mammals evolved in wooded habitats, so it is no surprise to find that woodland remains very important for them. Badgers *Meles meles*, Roe Deer *Capreolus capreolus*, Fallow Deer *Dama dama* and even Red Deer *Cervus elaphus* are essentially woodland animals, although they are now also found in more open habitats. Red Squirrels *Sciurus vulgaris* have moved into some conifer plantations, but are still found in native woods. In the long-term, they are likely to be displaced from this habitat by Grey Squirrels. Unless an effective control measure can be found for the greys, native woods cannot be managed to retain their Red Squirrel populations.

Fallow Deer (Paul McLaughlin)

All bats feed in and around trees. Some, such as the Brown Long-eared Bat *Plecotus auritis* are so dependent on woodland that they are rarely found in other habitats, whilst Leisler's Bat *Nyctalus leisleri*, found in woods in the Cree valley, is virtually absent from the rest of Scotland. The essential habitat requirement appears to be holes and crevices for roosting, best created by the retention of standing **decaying wood**.

3.7 Reptiles and Amphibians (medium importance)

A number of reptiles and amphibians are found within native woods, particularly in woods with extensive open spaces. Amphibians breed in **woodland ponds** that are at least partly unshaded.

4. Environmental, Economic & Social Importance of Biodiversity

- Landscapes are significantly enhanced by native woods, which soften open hillsides and plantations.
- Native woods are part of our cultural heritage and have a long association with landscapes. This is reflected in many local place names in Gaelic, Scots, Welsh as well as English, and in songs and paintings.
- Archaeological relics dating back to prehistoric times, and sometimes more recent features such as deserted shielings or ruined croft houses are often found within native woods. Those woods with a coppice history have been part of the local landscape for centuries. They and the woodbanks which define them will be amongst the oldest historical monuments in some areas.
- A number of native woods are managed as nature reserves and/or have footpaths and interpretation, providing a valuable recreation and tourism resource.
- Upland woods can often provide valuable shelter for sheep and cattle and can give good grazing. However, grazing pressure needs to be carefully managed to avoid risking the survival or ecological value of the woods.

5. Factors affecting the Habitat

- The native woods of Dumfries & Galloway are generally long and narrow, concentrated in the river valleys and in strips at the coast. This produces a **greater edge effect than the national average.**

- **Overgrazing** by sheep, deer and rabbits leading to change in the woodland structure, ground flora impoverishment and difficulties for regeneration.
- **Air pollution** affects lichen and bryophyte communities, though this is localised in Dumfries & Galloway.
- **Invasive species** such as *Rhododendron*, Cherry Laurel, Snowberry, Sycamore, Beech and other species leads to changes in the composition of the woods and the ground layer and threatens woodland regeneration.
- Management of native woods for game can be compatible with high biodiversity, but the **strawing of rides, use of release pens and introduction of exotic trees and shrubs** can all be damaging. The higher the number of pheasants in a wood, the greater is the chance of damage.
- Ditching and other **drainage** measures, including the loss or dredging of woodland ponds reduces biodiversity value.
- **Nutrient enrichment** leading to changes in soils and ground flora may occur from spray drift or runoff from adjacent agricultural land.
- In some cases, **unsympathetic forest management**, where felling rates, choice of broadleaf species planted, or methods of working do not yet reflect published guidelines.
- **Clearance of dead wood**, an essential component of woodland ecosystems, on the grounds of safety or neatness reduces biodiversity value.
- **Abandonment of practices** such as coppicing may in some areas lead to a reduction in structural diversity within the woods.

6. Strategic Actions

6.1 Recent and current activity

- **Forestry Commission Scotland** is involved with many native woodland projects, including managing grazing to assist natural regeneration, removal of *Rhododendron* and the restoration of plantations on ancient woodland sites (PAWS).
- **Scottish Natural Heritage** (SNH) carries out monitoring of designated woods and works with their owners on subsequent management.
- A large mixed upland native wood is being created by **Borders Forest Trust** at Carrifran in the Moffat Hills.
- Conservation organisations such as **RSPB** and **Scottish Wildlife Trust** own and manage a number of native woods. RSPB have begun to create 371ha of new native wood at Barclye, adjacent to Wood of Cree.
- Cree **Valley Community Woodlands Trust** has been working since 1996 to restore and link fragments of native woodland in the Cree valley.
- The **South West Community Woods** are strongly orientated to native trees and woods.

6.2 Other recommended actions

- **Expand native woods** through natural regeneration wherever possible.
- Where natural regeneration is not feasible, **maintain genetic integrity** by careful selection of planting stock.
- **Maintain existing native tree species composition**, including birches, willows and shrubs such as Hawthorn.
- **Maintain a high structural diversity** with trees of different ages and sizes, to ensure that there will be a continuity of habitat availability. A variety of aspects and degrees of exposure and shading should also be retained to provide a range of microclimates.
- Implement local integrated strategies for **management of deer and feral goats**.
- Ensure that proposals for **new non-native plantations avoid native woodland** and areas that could potentially be used to link native woods.
- **Survey the native woodland resource** in Dumfries & Galloway using standard methods. Focus on neglected, un-recorded, moribund and small woodlands (less than 2ha). Identify sites where restoration is possible.
- **Research the possibilities for reviving the economic value** of producing timber from native woodlands, with particular attention to local markets.
- **Raise awareness** of the importance of native woods, through guided walks, open days, illustrated talks and publicity.

NATIVE WET WOODS

Priority Action (NWW1)

Restore native wet woods on forested sites, giving priority to sites that connect wetland or woodland habitats of high biodiversity value.
Target: Restore 190ha by 2012.
Lead partner: Forestry Commission Scotland.

Priority Action (NWW2)

Expand native wet woods.
Target: Expand by 440ha by 2012.
Lead Partner: Forestry Commission Scotland.

Dense birches and willows at Lochaber Loch. August 2007. (Peter Norman)

1. Habitat Description

Also see general information on all types of Native Woods

1.1 Physical Characteristics

Native wet woods are found beside rivers and lochs, on floodplains and as small patches within larger wooded areas when damp ground is colonised by species such as willows, birches and Alder. They may be seasonally flooded or constantly wet, and occur on a wide range of substrates from acid to base-rich, and peaty to mineral soils.

Wet woodland often represents a transient successional stage between open wetland areas and drier woodland, but in some locations it can be relatively stable. Wet woods immediately adjacent to rivers and lochs are referred to as riparian woods, those on mires as bog woods, whilst woodland composed primarily of willows or Alder is often termed carr. **Dead wood** can be frequent in all of these, as many of the trees are short-lived species.

In seasonally flooded woods, the **flood zone** may be periodically enriched with nutrient from silt. This may extend some way up the trunks of the trees. Floods also wash in large quantities of material from other habitats, and **decaying organic litter** on the woodland floor is often abundant. Extensive networks of branching runnels or **ditches** occur in many wet woods. These are exploited by an important and exceptionally diverse fauna in the mud and detritus in and around the watercourse, although the level of shade often results in little vegetation.

1.2 National and International Context

Scotland is estimated to have around half of the wet woodland resource of the UK, totalling approximately 35,000ha. Most of this occurs in the Highlands, but Dumfries & Galloway is probably the next most important area for this habitat.

2. Dumfries & Galloway Status

2.1 Recent Trends

Habitat loss has been partially reversed in the last two decades, with extensive planting of riparian trees along rivers, particularly by fisheries bodies. However, the only significant management of carr and bog woods has been clearance of spreading trees where they threaten more valuable wetland habitats.

2.2 Current Distribution

Though native wet woods are widespread and fairly common across Dumfries & Galloway, particularly, though not exclusively in the lowlands, they are highly fragmented. Few, if any, sites extend to more than 2ha.

2.3 Site Examples

Most lowland lochs in Dumfries & Galloway have at least a narrow fringe of wet native woodland, such as at **Castle Loch** (SPA/SSSI/LNR). Other native wet woods occur in river floodplains such as at **Wood of Cree**, and on the sites of silted-up lochs, such as **Ladypark** Scottish Wildlife Trust reserve in Dumfries, **Dowalton** (SSSI) in the Machars and **Barscraigh** (LWS) in Dalbeattie Forest.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with native wet woods, and the following action plans may also contain relevant information: River Headwaters, Lowland Rivers and Backwaters, Lowland Burns and Ditches, Eutrophic Lochs, Mesotrophic Lochs, Fens, Marshes, Raised Bogs, Native Woods, Scrub Woods.

3. Importance for Associated Species

3.1 Non-flowering Plants (very high importance)

Native wet woods have a well-developed moss and liverwort flora. Typical ground bryophytes include Feather Moss *Eurhynchium praelongum* and Forest Star Moss *Mnium hornum.* Blunt-leaved Bog-moss *Sphagnum palustre*, Girgensohn's Bog-moss *Sphagnum girgensohnii* and Fringed Bog-moss *Sphagnum fimbriatum* are shade-tolerant species found amongst birches and willows. On the trees themselves, there are many epiphytic species on willow. Alder is relatively species poor, though a few notable species have been recorded in other parts of Britain.

Blunt-leaved Bog-moss Sphagnum palustre. Killiegowan Wood, Gatehouse of Fleet, February 2007. (Peter Norman)

In the **flood zone** there are several typical species on exposed roots and tree bases enriched with silt from flooding, including Many-fruited Leskea *Leskea polycarpa*, Kneiff's Feather-moss *Leptodictyon riparium* and Blunt Feather-moss *Homalia trichomanoides*. None are particularly common in Dumfries & Galloway. The nationally scarce Spruce's Bristle-moss *Orthotrichum sprucei*, a riverside epiphyte of Alder, Ash, and willows where occasionally inundated, has been recorded beside Cargen Water, near Dumfries. Flood moss *Myrinia pulvinata*, a rare species in Scotland, is known only from Kenmure Holms.

Royal Fern *Osmunda regalis*, found in fen-carr woodland, declined heavily as a result of habitat loss and collecting in Victorian times. Though it is now recovering, it remains uncommon.

3.2 Invertebrates (very high importance)

The number of invertebrates associated with Alder, birches and willows is very large, and wet woods support many species which are rare in Britain. A snail *Leiostyla anglica* associated with this habitat type is virtually endemic, being otherwise known only from a tiny area of western France. The association of **dead wood** with water provides specialised habitats not found in dry woodland types. A large number of craneflies specialise in this habitat, including the scarce *Lipsothrix errans*, the larvae of which probably live in submerged rotting wood. Standing dead wood is also valuable for the larvae of species such as Lunar Hornet Clearwing moths *Sesia bembeciformis* that live within willow trunks.

Many invertebrates are associated with fungi, and wet woods are probably the most important single habitat for a range of fungus-feeding flies. Larvae of the hoverfly *Helophilus hybridus* are often associated with wet, **decaying organic litter**, as are soldier beetles *Malthodes dispar*. A nationally scarce spider *Maro sublestus*, has also been recorded in fens and wet woods in Kirkcudbrightshire.

Ditches and their margins support a special fauna. Strongly shaded ditches with choked with saturated organic mud provide the special habitat but biodiversity is richest where some light penetrates to allow herb or aquatic plants to grow. Even quite small wet seepages may support important invertebrates.

3.3 Fungi and Lichens (very high importance)

Willow Gloves *Hypocreopsis lichenoides* is a small but distinctive fungus that is no longer known in the wild in Britain, although herbarium collections remain. It grows on willow branches and was recorded near Dalry and Moniaive in the late 19th century. More typical fungi include Blushing Bracket *Daedaleopsis*

confragosa and Alder Bracket *Inonotus radiatus.* Lichen diversity is greatest on old trees rather than the relatively young ones that comprise the majority of wet woods. However, important species do occur. Despite its name, Scotland is the European stronghold for Norwegian Specklebelly *Pseudocyphellaria norvegica*. It grows on moss-covered trees in woods and willow carr, and has been found at a few sites in Galloway.

3.4 Fishes (high importance)

Well managed riparian woodlands provide essential habitat in the life-cycle of various fish, especially Trout *Salmo trutta.* They assist in reducing the siltation of spawning grounds, supply invertebrate and leaf-litter food, and provide shade and shelter.

3.5 Mammals (high importance)

The combination of woodland and wetland provides ideal conditions for bats, supporting large quantities of invertebrate food. Trees also provide roost sites and shelter for bats foraging over water. All bat species make use of such conditions. Otter *Lutra lutra* dens, or holts, are frequently located in flood debris or in mature bankside trees with root cavities such as oaks and Ash, although non native species such as Sycamores are also used.

3.6 Birds (medium importance)

A high density of breeding birds occurs in wet woods. Mostly these are common woodland species including Long-tailed Tits *Aegithalos caudatus*, Redpolls *Carduelis cabaret* and Willow Warblers *Phylloscopus trochilus*, the latter species now possibly declining nationally. Willow Tits *Poecile montanus* are certainly in rapid UK decline and Dumfries & Galloway is now their Scottish stronghold. They excavate new nest holes each year, so require dead wood and partially decayed trees. Woodcocks *Scolopax rusticola* require soft ground to probe for invertebrates, and are therefore often found in wet woods.

3.7 Flowering Plants (medium importance)

Native wet woods frequently contain species that are characteristic of fens and marshes. These include Marsh Marigold *Caltha palustris*, Wild Angelica *Angelica sylvestris* and Meadowsweet *Filipendula ulmaria*. A number of scarce species also occur in Dumfries & Galloway, including Elongated Sedge *Carex elongata,* a nationally scarce species found at a number of sites, particularly favouring Alder woods; and Sawwort *Serratula tinctoria* found in a range of wet habitats, including wet woods in the Dee and Urr valleys.

Bird Cherry flowers. Caldons Wood, May 2006. (Peter Norman)

3.8 Reptiles and Amphibians (medium importance)

Several of the commoner amphibians – Palmate Newts *Lissotriton helvetica*, Common Toads *Bufo bufo*, and Common Frogs *Rana temporaria* breed and overwinter in wet woodland, so long as the canopy is not so dense as to keep waterbodies in constant shade.

4. Environmental, Economic & Social Importance of Biodiversity

- Despite their relatively limited extent, native wet woods make a significant contribution to the landscape of the region. This is particularly the case in some farmland and upland areas where they may constitute the majority or even the only native trees in the landscape.
- Native wet woods are of fundamental importance to the health and productivity of freshwater ecosystems, capturing and recycling nutrients. In certain situations the input of leaves and other organic matter can provide 90% of a stream's energy budget.

Fallen timber and pools are important invertebrate habitats. Killiegowan Wood, February 2007. (Peter Norman)

- Riparian woods protect river banks and control erosion.
- Along with other natural riparian habitats, native wet woods ameliorate the effects of heavy rainfall and reduce the downstream risk of flash floods. They may also act as a buffer, intercepting excessive nutrients and reducing the risk of water pollution.

5. Factors affecting the Habitat

- **Clearance and/or coniferisation** of wet woods for agriculture or intensive forestry have occurred in the past.
- **Fragmentation.** By their nature, wet woods are small and localised. However, they would have often been linked to each other though semi-natural habitats such as wetlands.
- **Water pollution and nutrient enrichment** from agricultural run-off affects wet woods and species associated with them, especially bryophytes and invertebrates.
- **Lowering ground-water** in wet woods results in an invasion of Nettles and Brambles and loss of biodiversity.
- **Removal or major disturbance of flood debris**, tidying of fallen wood from streams, ditching of streams, and drainage or interception of seepages is extremely damaging to bryophytes and invertebrates.
- **Removal of old, diseased or larger moss-covered trees and dead wood** due to concerns over safety or hygiene.
- **Invasive species**, such as American Skunk Cabbage *Lysichiton americanus*, may have a localised impact.

6. Strategic Actions

6.1 Recent and current activity

- The **UK Forestry Standard** recognises the importance of riparian management.
- Riparian planting by **Galloway Fisheries Trust** and **district salmon fisheries boards**.

6.2 Other recommended actions

- **Collate existing information** to assess the current extent and distribution of native wet woods.
- Consider opportunities for the **creation of new native wet woods** through natural regeneration, or if necessary planting. Avoid open semi-natural habitats that are likely to already have a high biodiversity value, and important archaeological sites.

NATIVE ASH WOODS

Priority Action (NAW1)

Restore plantations on ancient Ash woodland sites.
Target: Restore 60ha by 2015.
Lead Partner: Forestry Commission Scotland.

Priority Action (NAW2)

Expand native Ash woods in areas currently of low biodiversity and archaeological importance, but that have the potential to link existing woods, especially ancient woods.
Target: Extend by 210ha by 2015 .
Lead Partner: Forestry Commission Scotland.

Coppiced Ash. Back Wood, Scaur Glen, May 2008. (Peter Norman)

1. Habitat Description

Also see general information on all types of Native Woods

1.1 Physical Characteristics

Ash woods mainly occur on neutral or alkaline soils. Canopy foliage tends not to be over-dense, thus allowing the growth of a flourishing and often diverse field layer flora. Other tree species are generally present in woodland of this type, such as Bird Cherry, Rowan and Wych Elm. Indeed, some small woods could be considered **elm woods**.

1.2 National and International Context

Ash woods are found throughout upland areas of Britain, but are particularly characteristic of limestone districts such as the Mendips, Pennines and around Morecambe Bay. Those in north-west Scotland are the most northerly examples of this type in the world. There are estimated to be 40,000–50,000ha of ancient semi-natural woods of this type.

2. Dumfries & Galloway Status

2.1 Recent Trends

Despite recent restoration and creation of native woods, Ash woods have received less attention than other woodland types.

2.2 Current Distribution

As a result of soils and climate Ash woods tends to be more common in the east of the region. There are few large woods, but a diverse range of small woods (less than 2ha) that contributes markedly to biodiversity. These are concentrated on steep slopes or poor soils in river valleys, particularly the parts of Nithsdale.

2.3 Site Examples

The best examples of upland Ash woods are concentrated in the tributary valleys of the River Nith, and include woods along the **Mennock Water** (SAC/SSSI); **Stenhouse Wood** (SAC/SSSI) in Shinnel Glen; **Chanlockfoot** (SAC/SSSI) in Scaur Glen; **Back Wood** (SAC/SSSI) on Crawick Water; and **Glenmaddie Wood** (LWS) on the Euchan Water.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with native Ash woods, and the following action plans may also contain relevant information: River Headwaters, Waterfalls, Upland Springs and Flushes, Native Wet Woods, Native Oak Woods, Native Birch Woods, Scrub Woods, Montane Scrub.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

Many native woods hold very diverse lichen communities and the alkaline bark of Ash and Wych Elm supports particularly important lichens, including rare species such as *Biatoridium monasteriense* on a single tree in Garlies Wood.

Lichen and moss covered Ash trunk. Glenmaddie Wood, June 2008. (Peter Norman)

There are relatively few fungi specifically associated with Ash. The best known is King Alfred's Cakes *Daldinia concentrica* on dead trunks and Shaggy Bracket *Inonotus hispidus* high up on mature trees. However, many other species are found in Ash woods on rotting wood or leaves.

Common Dog Violet, Scaur Glen, May 2006. (Peter Norman)

3.2 Flowering Plants (very high importance)

Well-developed Ash woods tend to have a more diverse flora than upland oak and birch woods. They are notable for displays of flowers, such as Bluebells *Hyacinthoides non-scripta,* Primroses *Primula vulgaris*, Dog's Mercury *Mercurialis perennis*, Common Dog Violets *Viola riviniana*, Wood Sorrels *Oxalis acetosella*, and Wood Avens *Geum urbanum*. A few less common species also occur, including Early Dog Violet *Viola reichenbachiana* at some of its few Scottish localities.

3.3 Invertebrates (very high importance)

Ash woods support a slightly different invertebrate fauna to oak and birch woods. They can be especially important for molluscs, which need calcium for their shells, and ancient upland Ash woods include some special species. Base rich **seepages** and springs in Ash woods support a number of rare species. Although of only moderate pH, the water in seepages is sufficiently rich in calcium to support diverse communities of molluscs, found amongst the vegetation and in saturated leaf litter. The snails *Acicula fusca* and *Spermodea lamellata* are associated with this habitat type; all are at their extreme west European distribution. *S. lamellata* is an indicator of ancient woodland. However, the invertebrate fauna of woodland seepages is very poorly known, and more survey work is urgently required in order to better inform decision-making.

The caterpillars of the rare Barred Tooth-stripe moth *Trichopteryx polycommata* feed on Ash, though have also been recorded on privet. Ash is also one of the better trees for **decaying wood** (saproxylic) insects, especially flies. These species are now some of the most threatened in Britain.

3.4 Mammals (very high importance)

There is little distinction between the mammal fauna of Ash woods and other kinds of native woods in Dumfries and Galloway; all are of very high importance for a wide range of species, especially bats.

3.5 Non-flowering Plants (high importance)

There is a wide variety of mosses, liverworts and ferns found in the region's native Ash woods. Big Shaggy-moss *Rhytidiadelphus triquetrus* grows most typically in woodland on more calcareous substrates where it forms a conspicuous part of the flora.

3.6 Birds (high importance)

The bird fauna of upland ash woods is less characteristic than other types, but all the typical woodland species are present.

3.7 Reptiles and Amphibians (medium importance)

A number of reptiles and amphibians are found within Ash woods, particularly in woods with extensive open spaces. Amphibians breed in **woodland ponds** that are at least partly unshaded.

4. Environmental, Economic & Social Importance of Biodiversity

- In common with other types of native woods, Ash woods provide landscape, cultural heritage, archaeological, recreation and tourism benefits.
- Mature upland Ash woods on fertile soils can often provide valuable shelter for sheep and cattle and can give good grazing. However, grazing pressure needs to be carefully managed to avoid risking the survival or ecological value of the woods.

5. Factors affecting the Habitat

- The native Ash woods of Dumfries & Galloway are generally **concentrated in narrow river valleys**. This produces a greater edge effect than the national average.
- Other factors affecting Ash woods are similar to those affecting other types of native wood.

6. Strategic Actions

6.1 Recent and current activity

- **Forestry Commission Scotland** has completed a survey of the current distribution of Ash woods in Dumfries and Galloway, and this has identified potential areas for expansion and creation of new Ash woods.
- **Scottish Natural Heritage** (SNH) carries out monitoring of designated woods and works with their owners on subsequent management.

6.2 Other recommended actions

- **Expand native Ash woods** through natural regeneration wherever possible. Avoid open semi-natural habitats that are likely to already have a high biodiversity value, and important archaeological sites.
- Where natural regeneration is not feasible, **maintain genetic integrity** by careful selection of planting stock.

Dog's Mercury often dominates the springtime ground flora of Ash woods. Stenhouse Wood, May 2006. (Peter Norman)

NATIVE OAK WOODS

Priority Action (NOW1)

Restore plantations on ancient oak woodland sites.
Target: Restore 250ha by 2015.
Lead Partner: Forestry Commission Scotland.

Priority Action (NOW2)

Expand upland native oak woods in areas currently of low biodiversity and archaeological importance, but that have the potential to link existing woods, especially ancient woods.
Target: Expand by 300ha by 2015**.**
Lead Partner: Forestry Commission Scotland.

1. Habitat Description

Also see general information on all types of Native Woods.

1.1 Physical Characteristics

Although there are other types of oak wood in the UK, all of those in Dumfries and Galloway, even at low altitudes are best considered as **upland oak woods**. These are found on acidic, often shallow, leached brown earth soils and are characterised by a predominance of usually Sessile Oak in the canopy, along with some birch. Varying amounts of Holly, Rowan and Hazel are often the main understorey species. The range of plants found in the ground/field layer varies according to the underlying soil type and degree of grazing, ranging from Bluebell-Bramble-fern communities through grass and Bracken dominated ones to those dominated by mosses.

Coastal oak woods are essentially a form of upland oak wood that has been modified by maritime influences. The trees are often stunted and pruned by wind and salt exposure.

1.2 National and International Context

Upland oak woods are found in western and northern Britain from southernmost Cornwall to north-west Scotland. In parts of Exmoor, Snowdonia, Lake District, and Argyll they form important elements of the finest landscapes. There are estimated to be 60,000–70,000ha of ancient semi-natural woods of this type.

2. Dumfries & Galloway Status

2.1 Current Distribution

As a result of soils and climate, oak woods are more common in the west of the region. There are few large woods, but the range of small woods (less than 2ha), concentrated on steep slopes or poor soils in river valleys, contributes markedly to biodiversity. These are most frequent in the Cree and Fleet valleys, with a few on the coast.

2.2 Site Examples

Buchan and **Glenhead Woods** (SAC/SSSI) in Glentrool probably provide the best examples of upland native oak woodland. Nearby **Caldons Wood** (SAC/SSSI) also has areas of upland birch wood. Though at lower altitude, there are many other good examples of upland oak type woods, including **Wood of Cree** (SAC/SSSI), **Holm Wood** (LWS) **Camer Woods** (LWS) and **Blackcraig Wood** in the Cree valley; **Killiegowan Wood** (SAC/SSSI), **Carstramon Wood** (SAC/SSSI) and **Cardoness Wood** (LWS) in the Fleet valley; and **Airds of Kells Wood** (SSSI), **Hannaston Wood** (SSSI), and **Oaks of Kirkconnell** in the Dee-Ken valley. **Lochwood** (SSSI), near Beattock is dominated by oaks, but has a history of wood pasture, rather than woodland.

Coastal oak woods include **Ravenshall Wood** (SSSI) at Carsluith, **Heughwood** (SSSI) at Southwick and **Gibb's Hole Wood** (LWS) at Almorness.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with native oak woods, and the following action plans may also contain relevant information: River Headwaters, Waterfalls, Upland Springs and Flushes, Native Wet Woods, Native Ash Woods, Native Birch Woods, Scrub Woods, Montane Scrub.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

Though fungi are widely distributed in all native

woods, there are some species that are restricted to oak, such as Beefsteak Fungus *Fistulina hepatica*, Oak Milk-cap *Lactarius quietus* and Hen of the Woods *Grifola frondosa.*

Beefsteak Fungus Fistulina hepatica. Holy Linn, September 2006. (Peter Norman)

Wet and mossy upland oak woodland is an exceptionally rich lichen habitat. The moss forms a base on which the rare, but conspicuous 'Lobarion' lichen community is found, including **Tree Lungwort lichen** *Lobaria pulmonaria*. Though internationally rare lichens are not as plentiful as in the Atlantic oak woods further north, a few examples of such lichens have been recorded from several Galloway oak woods.

3.2 Non-flowering Plants (very high importance)

The mosses, liverworts and ferns found in the region's native woods show a similar distribution to lichens. Upland oak woods, though generally not as diverse and rich as those in the west Highlands, are particularly important.

Little Shaggy-moss *Rhytidiadelphus loreus* is a common species of acidic upland woodland where it forms conspicuous stands. Shaded Wood-moss

Little Shaggy-moss Rhytidiadelphus loreus carpeting boulders. Hannaston Wood, February 2008. (Peter Norman)

Hylocomiastrum umbratum is found in hilly districts of western Britain where it occurs on the ground in open woodland, in turf and amongst rocks and scree. It is uncommon in Dumfries & Galloway.

Greater Whipwort *Bazzania trilobata* is a classic liverwort of oak woods in western Britain: it can be an abundant component of the ground layer in the most humid wooded valleys, but is restricted to the rockiest sections of less humid woods. As well as growing on the ground and on rocks, it can colonise logs or grow on tree trunks but it is seldom found away from woods. Trunk Pawwort *Barbilophozia attenuata* is found on decaying tree stumps and the trunks of acid-barked trees.

Rarer liverworts include Deceptive Featherwort *Adelanthus decipiens*, typical of the best Atlantic oakwoods in western Scotland. It has been recorded just once in Dumfries & Galloway, at Bargaly Glen in 1975. Outside of Britain it is known only in France and Spain. Brown Scalewort *Radula aquilegia* is a liverwort that is endemic to Europe, with its world headquarters in the west of Britain. There are several historical records from the New Galloway area, most recent of which was in Hannaston Wood in 1975. Hutchins' Hollywort *Jubula hutchinsiae* has been recorded in damp shady woodland at Chlenry Burn, and *Jamesoniella autumnalis* has been found on decaying wood.

3.4 Invertebrates (very high importance)

Acidic **oak woods** have a number of invertebrates in common with birch woods. The soldier beetles *Malthodes flavoguttatus* and *M. fuscus* are most frequently found here, whilst the Hollowed Glass Snail *Zonitoides excavatus* is the only British snail that avoids base-rich habitats. It is usually found in the leaf litter of poorly drained places in old established birch and oak woods.

Different species typically exploit different sub-habitats of native oak woods. A wide range of invertebrates occur on the leaf litter of the **ground layer**, including the common ground beetles *Abax parallelepipedus*, *Agonum ass*imile and *Calathus piceus.*

The **canopy** holds important invertebrates that are rarely seen at lower levels. The Great Prominent moth *Peridea anceps* appears restricted to larger native woods in Dumfries & Galloway, so far recorded only in Kirkcudbrightshire. Its caterpillars are associated

with the oak canopy. Purple Hairstreak *Neozephyrus quercus* butterflies, near the northern edge of their range in Dumfries & Galloway, pupate on the ground but spend most of their adult lives in the oak canopy.

3.5 Birds (very high importance)

Upland **oak woods**, especially those with a poorly developed understorey have a very characteristic bird fauna. The typical species are Pied Flycatchers *Ficedula hypoleuca,* Redstarts *Phoenicurus phoenicurus,* Tree Pipits *Anthus trivialis* and Wood Warblers *Phylloscopus sibilatrix.*

3.6 Mammals (very high importance)

There is little distinction between the mammal fauna of oak woods and other kinds of native woods in Dumfries and Galloway; all are of very high importance for a wide range of species, especially bats.

3.7 Flowering Plants (high importance)

The **field layer** of upland native oak woods is typically not as varied as other woodland types, being dominated by non-flowering plants. Ungrazed and lightly grazed native woods at lower altitudes have the greatest range of species, including Bluebells *Hyacinthoides non-scripta,* Wood Anemones *Anemone nemorosa* and Wood Sorrels *Oxalis acetosella*.

Bluebells at Carstramon Wood. May 2004. (Peter Norman)

3.8 Reptiles and Amphibians (medium importance)

A number of reptiles and amphibians are found within oak woods, particularly those with extensive open spaces. Amphibians breed in **woodland ponds** that are at least partly unshaded, though the more acidic conditions of oak woods may limit species composition in comparison to Ash woods.

4. Environmental, Economic & Social Importance of Biodiversity

- In common with other types of native woods, oak woods provide landscape, cultural heritage, archaeological, recreation and tourism benefits.

5. Factors affecting the Habitat

- The native oak woods of Dumfries & Galloway are generally **small in extent and concentrated on steep slopes** in the river valleys or on the coast. This produces a greater edge effect than the national average.
- Other factors affecting oak woods are similar to those affecting other types of native wood.

6. Strategic Actions

6.1 Recent and current activity

- **Forestry Commission Scotland** is involved with many native oak woodland projects, including managing grazing to assist natural regeneration, removal of *Rhododendron* and the restoration of plantations on ancient woodland sites (PAWS).
- **Scottish Natural Heritage** (SNH) carries out monitoring of designated woods and works with their owners on subsequent management.
- Conservation organisations such as **RSPB** and **Scottish Wildlife Trust** own and manage a number of native oak woods. RSPB have begun to create 371ha of new native wood at Barclye, adjacent to Wood of Cree.
- Cree **Valley Community Woodlands Trust** has been working since 1996 to restore and link fragments of native woodland in the Cree valley. Most of these woods are of native oak.

6.2 Other recommended actions

- **Expand native oak woods** through natural regeneration wherever possible. Avoid open semi-natural habitats that are likely to already have a high biodiversity value, and important archaeological sites.
- Where natural regeneration is not feasible, **maintain genetic integrity** by careful selection of planting stock.

NATIVE BIRCH WOODS

Priority Action (NBW1)

Restore plantations on ancient birch woodland sites.
Target: Restore 20ha by 2015.
Lead Partner: Forestry Commission Scotland.

Priority Action NBW2

Expand upland native birch woods in areas currently of low biodiversity and archaeological importance.
Target: Expand by 430ha by 2015.
Lead Partner: Forestry Commission Scotland.

1. Habitat Description

Also see general information on all types of Native Woods.

Caldons Wood, Glentrool. May 2006. (Peter Norman)

1.1 Physical Characteristics

Upland **birch woods** are typically found on acidic, infertile soils. Birches, especially Downy Birch, are dominant in the canopy, and on the poorest soils there may be few other trees. On more fertile sites, oaks, Rowan, Aspen, Ash, Alder, Goat Willow, Wild Cherry, Bird Cherry, Hazel, Hawthorn and Blackthorn can all be found. Though birch woods are extensive in the Scottish Highlands, in other upland areas they often occur as patches in a mosaic with oaks and other broadleaves. Birches also occur commonly in other habitats, such as native wet woods and scrub woods.

1.2 National and International Context

In Britain, there are estimated to be 15–25,000ha of ancient semi-natural upland birch woods, but more recent semi-natural birch woodland occupies a considerably larger area than this. They occur throughout upland Britain but are much more extensive in the north, and nearly half of all broadleaved woodland in Scotland is upland birch.

2. Dumfries & Galloway Status

2.1 Recent Trends

Until quite recently, birches were often viewed as weeds within commercial woods and plantations. However, since the Forestry Commission's review of policy for broadleaves in 1985, the conservation and management of native birch woods has gradually become more important. New areas of birch woodland have recently been planted, and in the upland valleys birch is being locally successful in regenerating and colonising new ground where grazing pressure is reduced.

2.2 Current Distribution

The full extent and quality of semi-natural native birch woods in the region is not accurately known, but they are uncommon in the region and there are few large woods.

2.3 Site Examples

Caldons Wood (SAC/SSSI) in Glentrool has areas of upland birch, as well as oak.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with native birch woods, and the following action plans may also contain relevant information: River Headwaters, Waterfalls, Upland Springs and Flushes, Native Wet Woods, Native Oak Woods, Native Ash Woods, Native Birch Woods, Scrub Woods, Montane Scrub.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

There is a distinctive and substantial mycota in upland native birch woods. Probably the best known of all British fungi, Fly Agaric *Amanita muscaria,* is usually associated with birches, and the Birch Polypore *Piptoporus betulinus* is also well-known. There are also many brittlegills *Russula,* milk-caps *Lactarius* and webcaps *Cortinarius*. Hoof Fungus *Fomes fomentarius* was formerly found almost entirely on birches, but in recent years has spread to other trees. Many native birch woods also hold very diverse lichen communities.

Hoof Fungus Fomes fomentarius on birch. Caldons Wood, March 2007. (Peter Norman)

3.2 Invertebrates (very high importance)

Upland birch woods have a number of invertebrates in common with upland oak woods. The soldier beetles *Malthodes flavoguttatus* and *M. fuscus* are most frequently found here, whilst the Hollowed Glass Snail *Zonitoides excavatus* is the only British snail that avoids base-rich habitats. It is usually found in the leaf litter of poorly drained places in old established birch and oak woods. Birches are bettered only by willows and oaks in terms of the number of larger moths they support. Although birch-specific moths occur on birch within other habitats, birch woods have a characteristic moth fauna, including Yellow-horned *Achlya flavicornis,* Scarce Prominent *Odontosia carmelita* and the day-flying Orange Underwing *Archiearis parthenias.*

Invertebrate species that rely on **decaying wood** are now some of the most threatened in Britain. More than 700 species of flies and a similar number of beetles are dependant to some extent on deadwood in the UK and birch, which rots quickly, supports many species.

Yellow-horned Moth, a birch specialist. Caldons Wood, March 2007. (Peter Norman)

3.3 Mammals (very high importance)

There is little distinction between the mammal fauna of birch woods and other kinds of native woods in Dumfries and Galloway; all are of very high importance for a wide range of species, especially bats.

3.4 Non-flowering Plants (high importance)

There is usually an abundance of mosses and liverworts in birch woods, though rarer species are more usually associated with adjacent oak woods.

3.5 Birds (high importance)

Typical species of upland birch woods include Redstarts *Phoenicurus phoenicurus,* Tree Pipits *Anthus trivialis,* Redpolls *Carduelis cabaret* and Willow Warblers *Phylloscopus trochilus*.

3.6 Flowering Plants (medium importance)

The **field layer** of upland native birch woods is typically not as varied as other woodland types, being dominated by non-flowering plants.

3.7 Reptiles and Amphibians (medium importance)

A number of reptiles and amphibians are found within birch woods, particularly those with extensive open spaces. Amphibians breed in **woodland ponds** that are at least partly unshaded, though species composition may be limited in acidic conditions.

4. Environmental, Economic & Social Importance of Biodiversity

- In common with other types of native woods, birch woods provide landscape, cultural heritage, archaeological, recreation and tourism benefits.
- Birch is used mainly for firewood at present and is often regarded as worthless for timber because of the poor form of many present-day birchwoods. The latter is at least partly due to lack of tending and to browsing, which results in twisted coppice stems. Improvements in form can be expected with good management, at least with Silver Birch on the better sites. Good quality birch timber is in fact strong and versatile and can be sawn for general use. Straight birch stems make excellent turnery wood. Other potential uses could be developed if a sufficient supply of good quality birch was available.

5. Factors affecting the Habitat

- Birch woods rarely attract the same **level of interest** from the public and land managers as other types of woodland, such as oak woods.
- **Virtually no commercial use** is currently made of birch products.
- Other factors affecting Birch woods are similar to those affecting other types of native wood.

Birch wood at Slogarie, near Laurieston. February 2008. (Peter Norman)

6. Strategic Actions

6.1 Recent and current activity

- Under **Forestry Commission** policy, native birch woods within conifer plantations are retained during felling.

6.2 Other recommended actions

- **Expand native birch woods** through natural regeneration wherever possible.
- Where natural regeneration is not feasible, **maintain genetic integrity** by careful selection of planting stock.

SCRUB WOODS

Priority Action (SW1)

Promote the value of scrub woodland for biodiversity.
Lead Partner: Scottish Natural Heritage/Dumfries & Galloway Environmental Resources Centre.

1. Habitat Description

1.1 Physical Characteristics

Scrub woods are composed of shrubs and small trees, usually less than 5m tall, often growing in dense, sometimes impenetrable stands, Much scrub occurs as a transition stage between open habitats and woodland, but in certain situations it can persist for decades, sometimes hundreds of years.

Juniper scrub, Tynron, February 2007. (Peter Norman)

Scrub grows in a range of different situations. Coastal scrub is found on shingle, dunes and coastal slopes; wet scrub on fens, raised bogs and as part of wet woods; scrub pasture on grazed grasslands and in parklands; and montane scrub above the tree line near mountain tops. Scrub also occurs in a highly-modified form as hedgerows. This action plan is concerned with scrub in the remaining situations – relatively dense semi-natural scrub woodland that is mostly ungrazed, occurring anywhere between the coast and close to the tops of the hills.

Scrub woodland can occur in isolated pockets, within woods or on the edge of woods. It can be composed of a variety of species and take a variety of forms. **Thorn scrub** is usually composed of Hawthorn and/or Blackthorn; **Gorse scrub** usually occurs on agricultural land and is often single species; Hazel usually occurs as a scattered understorey shrub within native woodland but **Hazel scrub** can form dense woods of its own; and **Juniper scrub** is a specialised and rare form of scrub woodland.

Although bramble is not a woody species and technically cannot form scrub, **Bramble thickets** can grow just as high and even more impenetrable than some scrub. Other species, such as Elder, Dog Rose and mature trees frequently occur as components of scrub woods.

1.2 National and International Context

There is little information on the distribution and abundance of scrub in Britain due to imprecise definitions and boundaries. The best estimate is that there was very approximately 900km^2 of scrub in Britain in 1990, of which 200km^2 was in Scotland. This includes coastal scrub, montane scrub and wet willow scrub, as well as the scrub types included in this action plan (but not birch or Alder scrub). All areas with a canopy cover of 50% or more were included.

2. Dumfries & Galloway Status

2.1 Recent Trends

No detailed information is available on recent trends in Dumfries & Galloway. Anecdotal evidence suggests that it may have increased in the last 10 years as a result of a reduction in stocking density, particularly in the uplands.

2.2 Current Distribution

Gorse scrub is the most widespread and abundant type of scrub woodland in Dumfries & Galloway, being especially extensive on many coastal peninsulas and some upland fringe areas. **Thorn scrub** is also widespread, perhaps being the most frequent type in the uplands. **Hazel and Juniper woods** are uncommon, the latter being restricted to the Nith valley.

2.3 Site Examples

There are many examples of Gorse and thorn scrub woods. **Banks of Dervaird** (LWS), near Glenluce, is an unusual wood in a local context, consisting almost entirely of Hazel scrub. **Tynron Juniper Wood** (SAC/SSSI), **Beuchan Juniper Wood** and **Keir Juniper Wood** are the only local examples of this type.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with scrub woods, and the following action plans may also contain relevant information: Coastal Shingle Beaches, Coastal Sand Dunes, Coastal Cliffs and Slopes, Raised Bogs, Native Wet Woods, Native Woods, Montane Scrub, Wood Pastures and Parklands, Traditional Field Boundaries, Roads and Verges.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Hawthorn Shieldbug, one of many invertebrates dependent on scrub. Minnigaff, May 2007. (Gavin Chambers)

Several scrub species are amongst the most important nectar-bearing plants for invertebrates in Britain. As a group, their importance is matched only by the umbellifers (many of which often grow in close association). Hawthorn, Blackthorn and Ivy are especially valuable, but **bramble thickets** in open, sunny situations are also very valuable for invertebrates.

There are also many invertebrates that feed on the leaves, flowers or other parts of scrub species. Willows, Blackthorn, Hawthorn, Hazel and Bramble each host more than 200 different UK species. Gorse and Juniper support many fewer species, but Juniper hosts several species that are specific to it alone, and are nationally rare. Moths and beetles are the most numerous of the groups represented.

Long Tailed Tits build their nests in dense scrub. (Gordon McCall)

3.2 Birds (high importance)

A number of species of birds nest commonly in scrub woods. These include Dunnocks *Prunella modularis,* Common Whitethroats *Sylvia communi,* Lesser Whitethroats *Sylvia carruca,* Willow Warblers *Phylloscopus trochilus,* Bullfinches *Pyrrhula pyrrhula,* Linnets *Carduelis cannabina* and Yellowhammers *Emberiza citrinella.* Several of these are in national decline. Other species, such as Black Grouse *Tetrao tetrix* and Long-eared Owls *Asio otus* use some types of scrub at certain times of the year as part of a wider habitat mosaic.

3.3 Non-flowering Plants (high importance)

Scrub is an important habitat for mosses and liverworts. Elder is the pre-eminent species for epiphytic mosses and liverworts, unsurpassed by any other tree in Britain, with species such as Wood Bristle-moss *Orthotrichum affine* found commonly only in association with this species. Hazel woods, especially where long established can also support notable bryophyte communities.

3.4 Flowering Plants (medium importance)

Broom, a colourful component of many scrub woods. Kate's Wood, Balmaclellan, May 2005. (Maggi Kaye)

A number of uncommon flowering plants are associated with scrub woods in Dumfries & Galloway, though the majority of these are restricted to coastal scrub. Western Gorse *Ulex gallii* is widespread in the lowlands of Kirkcudbrightshire, and sometimes forms dense patches. It is rare elsewhere in Scotland. Greater Broomrape *Orobanche rapum-genistae* is associated with Gorse and Broom. It suffered a dramatic national decline in the nineteenth and early 20th centuries and in Scotland is now largely restricted to the Nith valley.

3.5 Reptiles and Amphibians (medium importance)

Scrub woods with open areas are utilised by reptiles such as Adders *Vipera berus*, Slow Worms *Anguis fragilis* and Common Lizards *Zootoca vivipara*. Open grassy or rocky areas are used for basking, whilst the

scrub provides shelter. This shelter is also valuable, in some locations, for amphibians such as Great Crested Newts *Triturus cristatus.*

Fiery Milkcap Lactarius pyrogalus is associated only with Hazel (Peter Norman)

3.6 Fungi and Lichens (medium importance)

There are interesting fungi species associated with Hazel, Juniper and willow scrub, though less so with Blackthorn, Hawthorn or Bramble. Elder supports a good lichen flora, whilst Blackthorn scrub on the coast often has spectacular arrays of beard lichens *Usnea spp*. Hazel is even more important for lichens, with a number of rare specialist species recorded in Scotland. However few studies of Hazel lichens have been completed in Dumfries & Galloway.

3.7 Mammals (low importance)

Many mammals, including Badgers *Meles meles,* Foxes *Vulpes vulpes,* Rabbits *Oryctolagus cuniculus* and various deer, make use of scrub woods but these are common species and scrub is not a critical habitat component for any of them.

4. Environmental, Economic & Social Importance of Biodiversity

- Extensive areas of Gorse scrub form a distinctive landscape in parts of Dumfries & Galloway, especially during the main spring flowering period, and this contributes to the image of the region to tourists.

5. Factors affecting the Habitat

- Scrub is **rarely deliberately managed** as a habitat in its own right. Rather it is allowed to expand when management of open habitats is reduced or abandoned, or cleared when management of open habitats is initiated or intensified.
- **Unmanaged scrub can encroach** on more valuable biodiversity habitats and archaeological sites. Open, patchy scrub woods tend to support a greater biodiversity than dense thickets, but without low intensity management there is a tendency for open areas to be lost.
- Juniper woods have suffered from **overgrazing and burning**, diminishing its range.

6. Strategic Actions

6.1 Recent and current activity

- **Scottish Natural Heritage**, in association with the site's owner, support the management of Tynron Juniper Wood with the aim of regenerating Juniper, or restocking by planting where regeneration is not successful.

6.2 Other recommended actions

- **Survey** current local distribution, extent and value of scrub woods.
- **Assess where expansion** of scrub would be most desirable. The final decision should be made on a site by site basis but particular locations, such as the edges of native woods may be preferable. Avoid open semi-natural habitats that are likely to already have a high biodiversity value, and important archaeological sites.

Hazel scrub wood. Carlinstane Bank, Scaur Glen, May 2008. (Peter Norman)

MONTANE SCRUB

Priority Action (MS1)

Establish areas of montane scrub in Dumfries & Galloway.
Target: Establish a total of at least 40ha in 2 locations by 2015.
Lead Partner: Forestry Commission Scotland/Borders Forest Trust.

Planting montane scrub at Firth Hope, Carrifran. March 2008. (Borders Forest Trust)

1. Habitat Description

1.1 Physical Characteristics

Montane scrub consists of low-growing, crooked trees and shrubs. It occurs in a transition zone in the uplands between woodland and moss heath, in an environment where low temperatures, windy conditions and short growing season restrict the growth of tall woody species but they are not severe enough to prevent it entirely. It also occurs at higher elevations in sheltered gullies. However, only a few small remnants of montane scrub survive in Britain today, mostly on ungrazed ledges, but rarely on lightly grazed steep rocky slopes or boulder fields.

1.2 National and International Context

Montane scrub is a rare European habitat but is found on several European mountain ranges, most notably in Norway, Sweden, Finland and Czech Republic. A few small discrete stands of montane scrub occur in the Scottish Highlands, the biggest no more than 0.5ha. Elsewhere in Britain only a few scattered bushes survive in the Southern Uplands and Cumbria, though several restoration projects are underway.

2. Dumfries & Galloway Status

2.1 Recent Trends

There is virtually no evidence of the management or utilisation of montane scrub in Dumfries & Galloway in recent decades, presumably as so little of it exists. However, interest in this habitat has been increasing in Scotland, inspired by examples from Europe.

2.2 Current Distribution

A few remnants of montane scrub are found in the Moffat and Galloway Hills.

2.3 Site Examples

Tiny remnants of montane scrub occur at **White Coomb** (SAC/SSSI) and on the **Merrick** (SSSI). Montane scrub is being created at **Carrifran** (SAC/SSSI).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with montane scrub, and the following action plans may also contain relevant information: Acid Grasslands, Upland Heaths, Montane Moss-heaths, Native Woods.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Most remnant areas of montane scrub consist of a mixture of willows, including Dwarf Willow *Salix herbacea*, Downy Willow *Salix lapponum,* Dark-leaved Willow *Salix myrsinites and* Whortle-leaved Willow *Salix myrsinites.* However, there is no reason why other woody species such as Juniper *Juniperus communis,* as well as stunted trees such as oaks and birches, should not also form part of this habitat.

Plants such as Wood Cranesbill *Geranium sylvaticum* and Globeflower *Trollius europaeus*, usually now restricted in the uplands to ungrazed ledges, are occasionally found in montane scrub and may become more widespread with expansion of this habitat.

3.2 Invertebrates (high importance)

A number of invertebrates, including sawflies, moths and beetles, have been recorded as specialists on montane willow, though few if any of these have yet

been recorded in Dumfries & Galloway. *Pontania herbacea* has been noted as a gall on Dwarf Willow in the Moffat Hills.

3.3 Birds (medium importance)

Black Grouse *Tetrao tetrix* would benefit from areas of montane scrub. Other birds, including Ring Ouzels *Turdus torquatus* and other thrushes, Whinchats *Saxicola rubetra*, and finches would be likely to nest within the scrub.

3.4 Fungi and Lichens (medium importance)

Due to the rarity of this habitat in the UK, few studies have been completed on fungal associations. Research from elsewhere in Europe suggests that there may be a number of species restricted to this habitat.

3.5 Reptiles and Amphibians (low importance)

Adders *Vipera berus* and Common Lizards *Zootoca vivipara* would be likely to occur in montane scrub.

3.6 Non-flowering Plants (low importance)

As with fungi, little research has been completed on the importance of montane scrub in Dumfries & Galloway for mosses.

4. Environmental, Economic & Social Importance of Biodiversity

- Montane scrub could be used to soften the upper edges of conifer plantations, bringing visual improvements to upland landscapes.
- In such situations as above it would also shelter the plantation, increasing growth rates and reducing windthrow.
- Montane scrub would help prevent erosion, reduce leaching of soil nutrients, and contribute to a reduced risk of flooding in the catchment.

5. Factors affecting the Habitat

- Current environmental and grazing conditions are unlikely to result in the expansion of montane scrub.

6. Strategic Actions

6.1 Recent and current activity

- **The National Trust for Scotland** has erected a fenced exclosure at Grey Mare's Tail to prevent grazing of existing montane willows.
- **Borders Forest Trust** has designed areas of montane scrub into their Carrifran Wildwood Project.
- **Forestry Commission Scotland** and **Cree Valley Community Woodlands Trust** have initiated a montane scrub project in the Galloway Hills as part of Highland Birchwoods' Action for Mountain Woodlands Project. This involves propagating and planting out Downy Willow and Juniper above the conifers on Merrick.

6.2 Other recommended actions

- Incorporate montane scrub into **management of existing forests**.

Juniper, including dwarf forms, is a natural component of montane scrub. (Peter Norman)

VETERAN TREES

Priority Action (VT1)

Establish a veteran tree project to recruit and train volunteers, in order to identify, survey and publicise veteran trees.
Lead: Dumfries & Galloway Environmental Resources Centre/Woodland Trust.

Priority Action (VT2)

Raise awareness of the importance and management of veteran trees amongst countryside staff.
Target: Arrange 1 training course by 2009.
Lead: Dumfries & Galloway Biodiversity Partnership.

1. Habitat Description

1.1 Physical Characteristics

Technically, a tree becomes a veteran when the areas of successive annual rings in the main trunk begins to progressively decrease. However, it is rarely possible to detect such a feature and a range of less precise characteristics more usually identifies veteran trees. Veteran trees typically have greater than average quantities of **dead and decaying wood**; a large number of **hollows, holes and cavities** in the trunk and branches, often with naturally formed pools of water; areas of **damaged and lost bark** including **sap runs** where stress, wind, drought or collision damage extends from the bark to the conductive vessels; a large number of **epiphytic plants** such as ferns and lichens; and frequent **fungal fruiting bodies** of heart-rotting species. Ancient trees with such decay can survive for many years as only the bulky heartwood is affected and the living tissues are not killed. Indeed decay decreases the bulk of veteran trees, making them less susceptible to wind-throw.

Heavy-branched veteran birch. Holm Farm, Cree valley, May 2006. (Peter Norman)

Old age tends to produce many of the above characteristics and many veterans are large, old trees. However, these features can also result from a particular history of management in relatively young trees. Size and age are therefore not necessarily characteristics of all veteran trees. Trees that are old in relation to others of the same species are termed **ancient trees**. For example, birches may become ancient at 100 years old, but oaks not until 300 years old. Most ancient trees also have a large girth in relation to others of the same species. There is considerable overlap between ancient and veteran trees, but one does not automatically follow the other.

Heritage Trees need not necessarily be veteran or ancient trees, but are associated with some aspect of cultural heritage, often a specific person or historical event. Very often such trees have individual names. Veteran trees can be of any species, both native and introduced, and it is possible for **scrub** species such as Hawthorn and Hazel to become veterans.

2. Dumfries & Galloway Status

2.1 Recent Trends

The value of veteran trees has only become widely recognised in Britain since the 1990s. However, this has been matched by an increased perception of danger from trees with dead and decaying wood, and a desire for increased 'tidiness'. They therefore remain extremely vulnerable.

Massive multi-stemmed oak. High Ardwall, Gatehouse of Fleet, April 2007. (Peter Norman)

2.2 Current Distribution

Veteran trees have been recorded throughout Dumfries & Galloway, but the current distribution is imprecisely known. A number are likely to occur on long-established private estates.

2.3 Site Examples

Lochwood (SSSI) near Beattock contains one of the best collections of veteran trees in Britain. Nearby **Raehills Estate** also contains important examples. A sample survey of the **Fleet Valley National Scenic Area** in 2005 identified more than 200 potential veteran trees.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with veteran trees, and the following action plans may also contain relevant information: Traditional Field Boundaries, Wood Pastures and Parklands.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

Fungi are critical in the ecology of almost all of the wildlife associated with old trees and some are themselves rare and restricted to only the oldest of trees. It is fungi which cause the decay and hollowing on which the other wildlife depends. The decay of heartwood and hollowing are a perfectly natural part of the ageing process of the tree, probably prolonging its life, and are not necessarily a sign of ill health.

Sulphur Polypore Laetiporus sulphureus. Knockman Wood, June 2004. (Peter Norman)

Oak Polypore *Piptoporus quercinus* is restricted to veteran oaks. It was discovered at Lochwood in 2005, the first and so far only location in Scotland for this internationally rare species. The rare Beeswax Bracket *Ganoderma pfeifferi* is restricted to old Beech trees, and was recorded in Glencairn Parish 2000. Some slow-growing lichens are only found on the bark of very old trees.

3.2 Invertebrates (very high importance)

Veteran trees in Britain are the most important in Europe for invertebrates, including many rare species. Even a single tree can be very important. Few surveys have been completed in Dumfries & Galloway, but a few typical species have been identified.

Short, stubby veteran Alder with holes through the trunk. Glenmaddie Wood, Sanquhar, June 2008. (Peter Norman)

Most invertebrates associated with veteran trees require **decaying wood**, but very often this needs to be of a particular stage of decay or in a specific part of the tree. For example, the nationally scarce cranefly *Ctenophora pectinicornis* is associated with rot holes in large broad-leaved trees, especially Beech. Larvae often occur in shattered ends of trunks and have been found in rotten boughs, but only those that have fallen from at least 10m high. It is widespread in southern Britain but scarce in the west and north. The larvae of the hoverfly *Xylota sylvarum* develops in wet decaying roots of broad-leaved trees, ascending up the trunk to pupate beneath the bark, and in rot holes. It is widespread in old woods and wood pastures. The larvae of the soldier beetle *Malthodes marginatus* develops in decaying wood or beneath bark on dead timber, whilst the adults are mainly predatory on insect larvae but also feed on decaying timber. The hoverfly *Criorhina berberina* lays its eggs around the base of stumps and on the underside of leaves next to stumps. The larvae develop in the heart rot of roots, whilst adults feed at Hawthorn blossoms. It is mainly associated with ancient woods and wood pastures.

Sap runs, are often small and inconspicuous but highly important for invertebrates. They should not be viewed as a sign of ill-health.

3.3 Mammals (very high importance)

Due to the presence of numerous deep narrow crevices, veteran trees probably constitute the single most important breeding habitat for bats in Dumfries & Galloway. All species use veteran trees,

but some, such as Noctules *Nyctalus noctula* rarely roost in buildings or other non-tree sites. Though little research has been completed, veteran trees are also likely to be used by many bats as hibernation sites.

3.4 Non-flowering Plants (very high importance)

A wide range of epiphytic mosses is found on veteran trees. Park Yoke-moss *Zygodon rupestris* is closely associated with veteran trees, whilst Marble Screw-moss *Syntrichia papillosa* is most typically a species of mature trees, although rarely it also grows on walls, stones or tarmac. It is an infrequent plant throughout Britain and Ireland.

3.5 Birds (high importance)

The **hollows, holes and cavities** in the trunks and branches of veteran trees are used as nest sites by many species of birds, notably Barn Owls *Tyto alba*, Redstarts *Phoenicurus phoenicurus* and Spotted Flycatchers *Muscicapa striata*. Furthermore, the quantity of **dead and decaying wood** allows those species that excavate their own nest hole, such as woodpeckers, to utilise veteran trees.

3.6 Flowering Plants (low importance)

Apart from the fact that the veteran trees are flowering plants themselves, very few flowering plants are directly dependent on them.

3.7 Reptiles and Amphibians (low importance)

Although all native reptiles and amphibians may occasionally be found in or on veteran trees, the habitat is of low importance for this group.

4. Environmental, Economic & Social Importance of Biodiversity

- All veteran trees are of historic interest. They are as much a part of Dumfries & Galloway's heritage as its castles and churches.
- A number of veteran trees have been the subject of paintings by local artists.
- Decaying trees play a critical ecological role, releasing nutrients into woodland ecosystems.

5. Factors affecting the Habitat

- **Poor knowledge** of veteran tree distribution, history and biodiversity value in Dumfries & Galloway.
- Limited knowledge amongst tree surgeons, statutory agencies and even conservation organisations of the importance of veteran trees and their **management**.
- A **public perception** that all trees with dead and decaying wood are of little biodiversity value, aesthetically offensive and potentially dangerous. Such perceptions frequently result in pressure to remove veteran trees.

6. Strategic Actions

6.1 Recent and current activity

- **The Woodland Trust** runs an Ancient Tree Hunt that encourages volunteers to find and collect information on ancient trees for a national database. Only a few have so far been recorded from Dumfries & Galloway.

6.2 Other recommended actions

- Produce, or contribute to the national production, of an illustrated field guide to identify the various forms of veteran trees and the history and ecology that has led to their current form.

Fat-trunked veteran oak. Boreland Hills, Gatehouse of Fleet, October 2004. (Peter Norman)

CONIFER PLANTATIONS

Priority Action (CP1)

Identify conifer plantations that could be converted to broadleaves as part of a forest habitat network.
Target: Complete forest habitat network study for Dumfries & Galloway by 2012.
Lead: Forestry Commission Scotland.

Priority Action (CP2)

Expand areas of long-term retention within conifer plantations.
Target: 100ha of new long-term retention by 2015.
Lead: Forestry Commission Scotland.

1. Habitat Description

1.1 Physical Characteristics

The primary purpose of most conifer plantations is timber production, though a few in the lowlands may also have landscape and game functions. They are composed wholly or mainly of coniferous trees, often dominated by stands of single species, typically non-native larches, Sitka Spruce or Norway Spruce. At the forest scale, species composition may be more mixed, with a variety of native trees and shrubs on the **forest edge**, or more rarely scattered throughout. Most plantations are on ground that has been drained by a network of **ditches** and deep ploughed prior to tree planting, although more recent plantations may have used alternative establishment techniques.

Forest trail in Dalbeattie Forest. August 2006. (Peter Norman)

The early years of forest growth, sometimes described as the **pre-thicket stage** (when the trees are approximately 0-12 years old), is perhaps the richest for biodiversity, especially in first rotation plantations where remnants of the previous habitat are present. During the **thicket stage** (10-30 years old) the trees form a dense canopy preventing most light from reaching the forest floor, resulting in an almost total absence of ground flora and understorey. Some plantations are thinned at this stage. The **high forest stage** (30-70 years old) results in a higher, sometimes more open **canopy** (especially in deciduous larch plantations), allowing more light to reach the forest floor and some re-establishment of ground flora. This is most marked at the forest edge. Most trees are harvested at 40-70 years old, before reaching maturity. Harvesting is frequently carried out using **clearfell** methods, though continuous cover forestry is increasingly being used. The site is then restocked for a second and subsequent rotation of trees. **Long-term retention** of mature conifers beyond this age is now being practised for biodiversity and landscape purposes in some locations.

1.2 National and International Context

Approximately 1,516,000ha (7%) of Britain is covered by conifer plantations, with 993,000ha in Scotland. Along with improved grasslands, conifer plantations are the most widespread and abundant of habitats in Dumfries & Galloway, with approximately 145,000ha (23% of the region) planted with conifers, almost 10% of all UK planting. Given the extent of conifer plantations in the region, their existing and potential value for biodiversity is of high importance.

2. Dumfries & Galloway Status

2.1 Recent Trends

In the last 20 years increasing attention has been given to the biodiversity of conifer plantations. This has prompted many second rotation forests to be planned to take account of nature conservation needs through the creation of a greater diversity of tree species and ages, management of rides and glades, retention of old stands with dead and dying trees, more sensitive treatment of watercourses and encouragement of understorey vegetation. In some instances, conifer plantations have been removed to recreate former habitats, especially raised bogs.

2.2 Current Distribution

Conifer plantations are widespread, especially in the uplands. All of Dumfries & Galloway's conifers, except for a tiny number of Junipers, are of plantation origin. Only in the Scottish Highlands do semi-natural woods of native Scot's Pines occur.

2.3 Site Examples

Extensive examples of conifer plantations are found at **Eskdalemuir**, **Forest of Ae**, **Mabie Forest**, **Dalbeattie Forest** and in **Galloway Forest Park**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with conifer plantations, and the following action plans may also contain relevant information: River Headwaters, Exposed River Shingle, Native Woods, Broadleaved and Mixed Plantations, Forest Roads and Rides, Forest Ponds.

The region's conifer forests may offer a last refuge for Red Squirrels. Loch Ken 2007. (Gordon McCall)

3. Importance for Associated Species

3.1 Mammals (very high importance)

The natural habitat of Red Squirrels *Sciurus vulgaris* in Dumfries & Galloway is native broadleaved woodland, but they also occur in low densities in conifer plantations from the **thicket stage** onwards. However, introduced Grey Squirrels are better able to compete for food and will eventually replace them in native woods. Large conifer plantations with few large-seeded broadleaves might provide the only long-term prospect for the survival of Red Squirrels in Dumfries & Galloway, although even here changes to species composition and age structure will be required.

Insect food for bats is usually plentiful in conifer plantations, but the harvesting of the trees prior to maturity limits the availability of holes, even in the high forest stage. Special provision has to be made for them, usually with boxes. More **long-term retention** of conifers, including retention of standing dead-wood, would increase their prospects.

Pine Martens *Martes martes* were reintroduced to Dumfries & Galloway in the 1980s. Since then, the extensive conifer plantations of the region have enabled their population to expand and increase, although they are rarely seen. A variety of other mammals have successfully adapted to conifer plantations. These include Badgers *Meles meles,* Roe Deer *Capreolus capreolus* and Red Deer *Cervus elaphus.*

3.2 Fungi and Lichens (high importance)

Conifer forests, even fairly recent ones, provide good habitats for larger fungi. If the total number of species is lower than native woods, then this is almost certainly due to the fact that plantations tend to be monocultures. Species such as the Saffron Milk-cap *Lactarius deliciosus* are even able to survive in the dense **thicket stage**, though rarer fungi tend to be associated with more mature trees. For example, the nationally rare *Fayodis bisphaeriga* and *Rhodocybe gemina* have been found in association with pine and other conifers in Kirkcudbrightshire, and *Galerina stylifera* in the Forest of Ae. Some species, such as *Pholiota flammans* recorded at Kirroughtree, are more usually found in Caledonian Pine Woods, whilst *Melanotus proteus*, an uncommon fungus of pine stumps, is from a predominantly a tropical/sub-tropical genus. A number of species, such as the Larch Bolete *Suillus grevillei,* have been introduced into Britain as a result of the creation of conifer plantations.

Herald of Winter Hygrophorus hypothejus is restricted to pinewoods. Torrs Warren, November 2007. (Peter Norman)

Microfungi, including mycorrhizal species that are essential for the growth of most British plants, are less common in conifer plantations, often lost through soil disturbance during initial ploughing or subsequent use of heavy machinery.

The poor qualities of conifer bark, the lack of deadwood and old trees, excessive shade, and a lack of ecological continuity due to the clearfelling system make most conifer plantations poor in lichen diversity.

3.3 Birds (high importance)

Several birds, including Short-eared Owls *Asio flammeus* and Grasshopper Warblers *Locustella naevia* favour the **pre-thicket** stage of the conifer plantations. Second rotation forests have not so far provided the same benefits for these species as the original plantings.

Conifer plantations, especially in the **high forest** stage, are the favoured habitat for a number of species, including Song Thrushes *Turdus philomelos,* Coal Tits *Periparus ater*, Willow Warblers *Phylloscopus trochilus,* Goldcrests *Regulus regulus,* Siskins *Carduelis spinus* and Common Crossbills *Loxia curvirostra.* Only the latter species is restricted to conifers, the others also occurring in a range of other habitats. Chaffinches *Fringilla coelebs* are very common in conifer plantations and given the extent of this habitat in Dumfries & Galloway, regional numbers may well be significant in a UK context. A number of birds of prey also nest in plantations at this stage, and even more so in areas of **long-term retention**. These include Buzzards *Buteo buteo,* Sparrowhawks *Accipiter nisus,* Goshawks *A. gentilis* and Long-eared Owls *Asio otus.*

Dumfries & Galloway has many **forest edge** habitats which should offer potential for the foraging of Black Grouse *Tetrao tetrix*. Merlins *Falco columbarius* will also nest on the forest edge, so long as there is suitable adjacent open ground for hunting. Practical conservation measures within conifer forests have resulted in dramatic improvements in the number of Barn Owls *Tyto alba.*

Barn Owl, (Paul McLaughlin)

Dumfries & Galloway supports almost the entire Scottish population of Nightjars *Caprimulgus europaeus,* which nest and feed in forest clearings, including areas of **clearfell**. Forest restructuring may be able to provide suitable habitat continuity for these birds.

3.4 Invertebrates (medium importance)

Large, dense stands of conifers of uniform age are not of great interest for invertebrates. Those that do occur are either recent arrivals to Britain or common generalists that have spread from native plants. However, given their extent in Dumfries & Galloway, their overall total contribution to invertebrate biodiversity in the region is not insignificant. A few nationally scarce species, such a ground beetle *Trechus rubens,* also occur.

A number of new invertebrate species have been attracted to the **canopy** of conifer plantations, including several hoverflies. For example, *Eupeodes lundbecki*, although common in Europe, was recorded at one of its first locations in the UK at Tynron in 1984. Other recent colonists include *Eriozona erratica, E. syrphoides, Melangyna compositarum, Parasyrphus lineola*, and *P. malinellus.* The latter was new to science when discovered in 1952. Although most are predators of aphids and other canopy species, they also require the presence of flowers at ground level.

The caterpillars of Red-necked Footman moths feed on lichens growing on conifers. Glenwhan, July 2005. (Richard Mearns)

The importance of dead and decaying wood is usually associated with broad-leaved trees, but it is also of importance in **long-term retention** conifers. The longhorn beetles *Rhagium bifaciatum* favours dead and decaying pine, though it also occurs on other trees.

The Hairy Wood Ant *Formica lugubris* is regularly recorded in conifer plantations in the Highlands. There is a pre-1970 record from the Machars. Although it is now probably extinct, there is an outside possibility that a population may still exist in local forests.

3.5 Non-flowering Plants (low importance)

Although numbers of species and quantity of plants can be high, conifer plantations support a poor quality moss and liverwort flora, composed almost entirely of common species. Important species occur only where plantations contain remnants of former habitats, such as native woods or bogs, or sometimes on decaying large stumps or logs. One species of interest, Ostrich-plume Feather-moss *Ptilium crista-castrensis* is perhaps most typically a plant of northern Scottish pinewoods, where its growth can be quite luxuriant, but it has also been found, rarely, in pine plantations in Dumfriesshire.

3.6 Reptiles and Amphibians (low importance)

Conifer plantations in Dumfries & Galloway support virtually all of the region's reptile and amphibian species, but most occur at very low density within the trees. The most important areas tend to be localised open spaces, such as forest ponds or forest roads, or transient habitats such as **clearfell** areas.

3.7 Flowering Plants (low importance)

Rare plants associated with Caledonian pinewoods have been recorded in conifer plantations outside of the Highlands, including the Borders and Cumbria, but few, if any, are known from Dumfries & Galloway. As a result, the flora of conifer plantations generally consists of common and widespread flowering plants.

Following clearfelling there can be rapid recolonisation of flowering plants from adjacent or buried seed sources. However species tend to be opportunists, with little, if any recolonisation of pre-plantation flora.

3.8 Fishes (low importance)

No species of fish are strongly associated with conifer plantations. Indeed, poorly planned forests can exacerbate acidification of adjacent watercourses, severely depleting fish populations.

4. Environmental, Economic & Social Importance of Biodiversity

- Though conifer plantations are rarely economically profitable without state aid, they continue to provide economic and employment benefits to Dumfries & Galloway.
- The softwood timber produced in the plantations is generally of low quality but does supply a number of markets, typically for pulpwood.
- Given the extent of conifer plantations in Dumfries & Galloway, they make an important contribution to carbon sequestration. However this is rather limited in comparison to the totals for peatlands, semi-natural habitats and seas.
- Conifer plantations are well suited to outdoor recreation activities such as mountain-biking and paint-balling that may cause damage to less robust habitats.

5. Factors affecting the Habitat

- **Uniform age and species composition** of forests has not benefited biodiversity.
- There is the prospect of **shorter rotations** as timber processing becomes more efficient and timber markets change, which may impact on species associated with more mature trees.
- **Removal of** stumps for use in biomass power stations is likely to reduce fungal and bryophyte diversity of planted conifer plantations.
- Wind **and fire damage** can open up clearings in forests and encourage biodiversity associated with the catastrophic events that occur in natural ecosystems.

6. Strategic Actions

6.1 Recent and current activity

- The management and expansion of conifer plantations in the UK is regulated by the government through the **Forestry Commission**. Grants are paid where the management or creation of plantations is in accordance with UK forestry policy. This is set out in a series of publications: The UK Forestry Standard defines and applies government commitments to sustainability and biodiversity and this is augmented by a series of guidelines on biodiversity, landscape, water, archaeology and recreation.
- UK forestry policy addresses problems of uniform species cover, stipulating inclusion of a minimum proportion of minor conifer species together with open space and broadleaves. These elements are likely to comprise 20-30% of new and second rotation forests. The policy also provide guidance on continuous cover silvicultural systems and the identification of long term retentions to produce old trees.
- Local forest strategies, termed Forest Frameworks, have been developed by **Forestry Commission Scotland, Scottish Natural Heritage** and **Dumfries & Galloway Council** for Galloway and Lockerbie-Langholm to guide the location of new forests.

Eyed Ladybird, a conifer specialist. Kirkconnel, August 2007. (Greg Baillie)

6.2 Other recommended actions

- Direct any **new conifer plantations towards areas of low conservation value**, such as derelict industrial, low grade arable, and improved pasture, which will result in a net gain for biodiversity. Avoid semi-natural open habitats and native woods of a high conservation importance.
- Where feasible, **restore high biodiversity habitats** damaged by conifer planting.
- Identify locally, as well as nationally and internationally important habitats and species within and around conifer plantations and ensure actions for them are included in **forest plans.**
- Develop systems to **monitor the biodiversity** value of conifer plantations, for example by assessing critical habitat features and selecting key or indicator species.

BROADLEAVED & MIXED PLANTATIONS

Priority Action (BMP1)

Identify suitable locations for new broadleaved plantations as part of a forest habitat network.
Target: Complete forest habitat network study for Dumfries & Galloway by 2012.
Lead: Forestry Commission Scotland.

A mixed plantation, created entirely for recreation at Powfoot Lakes. July 2006. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Broadleaved and mixed plantations have been created for a number of purposes, most commonly game cover, timber, landscape and amenity, and wildlife conservation. Most have been planted on open ground or in some cases by under-planting of semi-natural woods. They are composed both of native and non-native broadleaved trees, often mixed with conifers, and occur primarily on more fertile ground in the lowlands.

Plantations of native trees should not be confused with semi-natural and/or ancient woods. As plantations mature, they take on many of the characteristics of such woods and can become more difficult to distinguish from them, but it is likely that none have yet acquired the complicated ecological inter-relationships of semi-natural ancient woods, and may not do so for many hundreds of years. Those with the best chance of doing so are those with a woodland type soil that has been least disturbed and modified during the period that the wood was absent. Plantations on highly improved agricultural soils may grow trees, but may never acquire a full woodland ecosystem.

1.2 National and International Context

The majority of Britain's broadleaved trees are of plantation origin. In Scotland, there was around 3000km^2 of broadleaved and mixed woodland in 1998, the majority of which was of plantation origin. This area will have subsequently increased.

2. Dumfries & Galloway Status

2.1 Recent Trends

The number and area of broadleaved plantations has been increasing in the last 20 years, encouraged by state grant programmes. Few have any significant timber value, but have been created for amenity, wildlife and game purposes. Short-rotation coppice is a very new form of plantation.

2.2 Current Distribution

Most woods in Dumfries & Galloway, even those composed of native species, are of planted origin. Larger plantations tend to be associated with private estates, houses or castles, but smaller woods of native oaks, birches, elms and Ash, often with non-native Beech, Sycamore and conifers, are also widespread. They often comprise a sinuous patchwork on agricultural land, and their historical origins are usually not obvious.

2.3 Site Examples

Cotland Plantation (SSSI) at Bladnoch is an old plantation, predominantly of oaks and Ash. It supports an interesting flora. Nearby, **Kilsture Forest** is the largest woodland in the Machars. **Cally Woods** at Gatehouse of Fleet was planted on top of a designed landscape in the 1930s, with oaks, Sycamore, Ash, Beech, Scot's Pine and Sitka

Beech plantation with characteristic sparse ground flora. Drumlanrig, September 2006. (Peter Norman)

and Norway Spruce the main trees. It supports good bird, bat, lepidoptera and fungi populations. Other important policy woodlands include those at **Drumlanrig, Kelhead** and parts of **Mabie Forest.**

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with broadleaved and mixed plantations, and the following action plans may also contain relevant information: Native Wet Woods, Native Ash Woods Native Oak Woods, Native Birch Woods, Scrub Woods, Veteran Trees, Conifer Plantations, Forest Roads and Rides, Forest Ponds, Wood Pastures and Parklands.

3. Importance for Associated Species

3.1 Fungi and Lichens (high importance)

A number of non-native trees are important for fungi and lichens. In particular Beech is crucial for a whole array of fungi, and Sycamore is important for lichens. The nationally rare Golden Bootleg Fungus *Phaeolepiota aurea* was recorded in a mixed open plantation in Kirkcudbrightshire and from Mabie Forest, both in 1993.

The spiny underside of the edible Hedgehog Fungus. St. Ann's, September 2006. (Peter Norman)

Chaffinch. (Paul McLaughlin)

3.2 Birds (high importance)

A wide range of birds is found in well-managed plantations, including various thrushes, tits and finches. Though very rare in Dumfries & Galloway, Hawfinches *Coccothraustes coccothraustes* may occasionally be found in plantations that contain Beech, Cherry and Hornbeam.

3.3 Mammals (high importance)

The mammal fauna of broadleaved plantations is little different to semi-natural native woods - management practices are of more importance than tree species composition. Bats in particular require the retention of mature and semi-mature trees with plenty of holes for roost sites.

3.4 Invertebrates (medium importance)

As a result of the poor colonising ability of woodland invertebrates, broad-leaved plantations lack the characteristic species of semi-natural ancient woods. Unless the plantation adjoins ancient woodland, the invertebrates will generally be common species that occur in a range of habitats. Nevertheless they can occur in high numbers. A few species of more restricted national distribution are known from mixed plantations, including the larvae of the hoverfly *Cheilosia longula* that feeds only within fungi growing under broadleaved and coniferous trees.

3.5 Reptiles and Amphibians (medium importance)

Reptiles and amphibians are more influenced by plantation structure than its age or species composition. Populations in open plantations can therefore be just as high as in native woods.

3.6 Non-flowering Plants (low importance)

Plants generally take much longer to colonise plantations than animals, especially if the plantations are isolated from existing ancient woods. As a result, most plantations lack the typical species diversity associated with ancient woods, though long-established plantations may have acquired at least some of them.

3.7 Flowering Plants (low importance)

As with non-flowering plants, the best plantations for flowering plants tend to be the oldest ones that have been least disturbed.

Common Figwort tolerates shaded habitats in plantations. Dalry, July 2007. (Maggi Kaye)

4. Environmental, Economic & Social Importance of Biodiversity

- Nature conservation is rarely the main reason for the establishment or management of broadleaved and mixed plantations. Most fulfil a variety of other roles including landscape, timber production, amenity, recreation, shelter and game cover.
- A survey by the Forestry Commission in 2003 found that 18% of the Scottish population had collected non-timber forest products in the preceding 12 months, mostly from mixed woods. 173 species were collected, mostly to eat or for medicinal or craft uses. Most products were for personal use and the collecting was considered to be of social and cultural importance, but some collecting also resulted in a modest economic income.

5. Factors affecting the Habitat

- Management work, including **felling and thinning**, can be damaging to bird and bat populations and ground flora, if carried out at sensitive times of the year.
- Creation of a dense shrub layer for pheasants in woods managed for game has sometimes been achieved by the **planting of potentially invasive shrub species** such as Rhododendron, Laurel and Snowberry.
- The **siting of pheasant release pens**, especially if intensively stocked can lead to soil enrichment and loss of ground flora.
- **Climate change** may affect tree species distribution throughout Britain. For example it has been suggested that conditions may become unsuitable for Beech in much of the south of England. Although not native to Scotland, in the future this tree may be more suited to environmental conditions in Dumfries & Galloway.

6. Strategic Actions

6.1 Recent and current activity

- New mixed plantations have been created at a number of locations including **Barfill Farm**, near Crockeford.

6.2 Other recommended actions

- Implement the same management techniques for broadleaved and mixed plantations as for native woods, wherever this does not conflict with other uses. Encouragement of **a diverse species and age structure, creation of open space, retention of wet areas and decaying wood,** can all usually be incorporated into management whilst retaining the primary purpose of the plantation.
- **Consider planting Beech woods** on ground of low biodiversity value. Do not plant Beech in existing semi-natural native woods.

Mixed broadleaved plantation. Cally Woods, Gatehouse of Fleet, July 2007. (Peter Norman)

FOREST ROADS & RIDES

Priority Action (FRR1)

Raise awareness of forest managers of the importance of forest roads and rides for biodiversity, and how best to manage them.
Target: Arrange training course by 2012.
Lead: Dumfries & Galloway Biodiversity Partnership/Butterfly Conservation/RSPB.

Forest road with grassland and scrubby edge. Potterland Hill, July 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Roads and rides have been constructed in both coniferous and broadleaved plantations for the purposes of forest management. **Roads** are access routes with metalled surfaces designed to support use by heavy timber transport vehicles. They are created by the removal of soil and re-profiling of the ground surface, and usually have associated drainage ditches. Passing/turning places and timber stacking/loading areas may also be present. **Rides** are unsurfaced and designed for infrequent use only by specialist off-road forestry vehicles. Wayleaves cut under power lines provide a very similar habitat to forest rides. Both roads and rides may also serve as firebreaks.

Both roads and rides provide a mosaic of open ground and vegetated habitats that is often more diverse than the surrounding plantation. Broadleaved shrubs and trees frequently occur, even in predominantly coniferous forests. Grassland, bare ground and wetland (ditch) habitats can also occur.

The greatest physical asset of roads and rides for biodiversity, in comparison to the interior of the forest, is the abundance of light. However, the presence of trees also provides shelter from wind, and there are often long intervals between bouts of disturbance.

2. Dumfries & Galloway Status

2.1 Recent Trends

Maintenance of roads and rides in the recent decades has, just like forest management, become increasingly mechanised and the tractor-drawn swipe or flail is the principal tool.

2.3 Current Distribution

Forest roads and rides are widely distributed through all of the region's larger forests.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with forest roads and rides, and the following action plans may also contain relevant information: Conifer Plantations, Broadleaved and Mixed Plantations, Forest Ponds, Quarries and Mineral Workings.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

Painted Lady, one of many butterflies that use open sunny roads and rides. Dunskey, August 2003. (Maggi Kaye)

The invertebrate fauna of forest roads and rides is generally of greater interest than that in the plantation, especially where plantations are composed of even-aged single species conifers. A number of species of butterfly have been retained following afforestation through the creation and management of suitable forest roads. These include the Pearl-bordered Fritillary *Boloria euphrosyne* at Mabie, the Grayling *Hipparchia semele* at Sandyhills and the Dingy Skipper *Erynnis tages* at Dalbeattie.

Moths are less dependent than butterflies on sunlight, but the abundance of broadleaved shrubs, particularly willows and birches, on forest roads and rides provides important foodplants. Other invertebrates have been little studied, but sun-loving groups such as bugs, bees, wasps and hoverflies are likely to be more common here than in the shade of the forest. Predatory insects of other habitats, such as dragonflies from forest ponds, are often attracted to hunt in the sheltered conditions provided by roads and rides.

3.2 Fungi and Lichens (high importance)

Roads and tracks through woods and plantations provide an important microhabitat for fungi including rare tooth fungi. These species appear to have a preference for fruiting in bare mineral soils and forest tracks often offer a perfect habitat. Many other fungi also fruit along forest roads, though it is not clear exactly why this is the case. Common forest road species include Orange-peel *Aleuria aurantia* and Shaggy Ink-cap *Coprinus comatus*.

Conical waxcap Hygrocybe conica on forest road. Mabie, August 2007. (Peter Norman)

3.3 Flowering Plants (medium importance)

The flora of roads and rides can be completely different to the forests through which they pass. A greater diversity of flowering plants is found on lowland forest roads and rides than in the uplands. Bird's-foot Trefoil *Lotus corniculatus,* Common Dog Violet *Viola riviniana* and Black Knapweed *Centaurea nigra* are typical species, all of which are important for butterflies. Bird's-foot *Ornithopus perpusillus*, a tiny localised plant of open grassland, has been found thriving on the disturbance created along some forest roads in the region.

Self Heal, often abundant on forest roads. Mark Hill, Colvend, July 2007. (Peter Norman)

In upland areas, several species have benefited from the reduced grazing pressure in forests, compared to adjacent sheep pastures. Bog Asphodel *Narthecium ossifragum* often flowers profusely and Heather *Calluna vulgaris* and Bog Myrtle *Myrica gale* grows tall along forest rides. Heath Cudweed *Gnaphalium sylvaticum*, one of the few native vascular plant species to benefit from the extensive afforestation programmes of the 20th century, grows on open woodland and forestry rides in areas of former heathland, though now appears to be in national decline and is locally rare.

In forests planted on bogs, once the canopy closes the only remnants of the original bog vegetation is usually to be found along rides, including Cranberry *Vaccinium oxycoccus*. Such plants provide a reservoir of seeds that can recolonise adjacent areas following harvesting, and are therefore valuable in any bog restoration projects. However, experience at Longbridge Muir and Moss of Cree suggests that this may be a very slow process.

3.4 Reptiles and Amphibians (medium importance)

Wide roads and rides are a good habitat for Common Lizards *Zootoca vivipara*. Common Frogs *Rana temporaria* may also breed in ditches.

3.5 Birds (medium importance)

Birds of forest roads and rides are more typical of the early stages of forests, rather than the more mature high forest stage. Species include Garden Warblers *Sylvia borin*, Chiffchaffs *Phylloscopus collybita* and Tree Pipits *Anthus trivialis*. Forests roads and rides may also be important for hunting Sparrowhawks *Accipiter nisus* and owls, and for the 'roding' display flights of Woodcocks *Scolopax rusticola.*

3.6 Mammals (medium importance)

In mature forests with sufficient bat breeding sites (caves, tree holes or bat boxes) for bats, linear features such as streams, roads and rides provide essential opportunities for feeding and movement of most species, especially if they link areas of semi-natural habitat. Indeed, forest roads and rides are the best places to locate bat boxes. They are also extensively used by feeding deer, and are ideal locations for deer control where required.

3.7 Non-flowering Plants (medium importance)

Stag's-horn Clubmoss *Lycopodium clavatum* and Alpine Clubmoss *Diphasiastrum alpinum* occur sufficiently frequently on the forest roads and rides to be an important part of the flora at almost all altitudes. Neither species is common in Dumfries & Galloway. Roadside ditches support a broad range of mosses and algae.

Green Tiger Beetles Cicindela campestris benefit from open sunny rides. Balloch Wood, August 2006.(Peter Norman)

4. Environmental, Economic & Social Importance of Biodiversity

- Roads and rides are the most publicly accessible part of forests, frequently used by walkers and cyclists. High biodiversity adds to the interest and enjoyment of such forest users.
- Game management can be compatible with management for biodiversity.

5. Factors affecting the Habitat

- Blanket application of herbicides as a way of managing forest roads is detrimental to biodiversity, especially flora and invertebrates.

6. Strategic Actions

6.1 Recent and current activity

- The forest roads around Lochaber Loch in Mabie Forest have been monitored for butterflies on a weekly basis by **Forestry Commission Scotland** during the summer for more than ten years, and management adjusted accordingly.

FOREST PONDS

Priority Action (FP1)

Assess the distribution and ecological importance of forest ponds in Dumfries & Galloway, by mapping their location and carrying out sample surveys.
Target: Map 100 and survey 25 forest ponds by 2015.
Lead: Forestry Commission Scotland/Dumfries & Galloway Environmental Resources Centre.

1. Habitat Description

1.1 Physical Characteristics

As with any other pond, the biodiversity value of forest ponds depends on a range of factors, including size, depth, bank profile, water quality, degree of shading and quantity of marginal and aquatic plants. All of these are influenced by the geological and environmental conditions of the surrounding landscape, but all can also be affected by the historic and current management regime.

Forest pond at Screel. August 2004. (Peter Norman)

2. Dumfries & Galloway Status

2.1 Recent Trends

The increased mechanisation of forestry means that excavation of new forest ponds has been much easier than in the past. As a result a number of ponds have been constructed in recent years, primarily for conservation and amenity purposes. These ponds have tended to have more natural contours and features than early forest ponds.

2.2 Current Distribution

Forest ponds are widespread within forests in Dumfries & Galloway. Although most forests are in the uplands, it is likely that the greatest density of forest ponds is located within forests at lower elevations.

Dalshinnie Loch in Mabie Forest. July 2004. (Peter Norman)

2.3 Site Examples

Some ponds that are known to have high biodiversity interest include **Penninghame Pond** and **Knockman Wood Pond** near Newton Stewart, **Borgan Pond** near Glentrool, **Dalshinnie Loch** (LWS) in Mabie Forest and **Earshaig Ponds** near Beattock.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with forest ponds, and the following action plans may also contain relevant information: Conifer Plantations, Forest Roads and Rides, Farm Ponds.

3. Importance for Associated Species

3.1 Invertebrates (high importance)

The sheltered environment of many forest ponds is ideal habitat for dragonflies, and there are numerous ponds that have recorded at least ten species. Usually common species are involved, but several forest ponds support populations of Variable Damselfly *Coenagrion pulchellum,* which has a restricted UK distribution. There have been fewer surveys of other invertebrate groups.

Common Darter, a typical dragonfly of forest ponds. Dunskey, August 2003. (Mike Kaye)

3.2 Reptiles and Amphibians (high importance)

With the exception of Natterjack Toads *Epidalea calamita*, all native amphibians (Common Toad *Bufo bufo,* Common Frog *Rana temporaria*, Great Crested Newt *Triturus cristatus*, Smooth Newt *Lissotriton vulgaris* and Palmate Newt *Lissotriton helvetica*) breed in forest ponds.

3.3 Flowering Plants (medium importance)

A range of flowering plants is found in, or on the edge of forest ponds: Water Forget-me-not *Myosotis scorpiodes*, Water Mint *Mentha aquatica*, Water Plantain *Alisma plantago-aquatica* and a number

of pondweeds *Potamogeton* spp. Forest ponds, especially in remote parts of the forest, are less frequently visited by botanists than more natural ponds.

3.4 Birds (medium importance)

Though there are no birds directly dependent on, forest ponds, they are visited by many species, including Grey Herons *Ardea cinerea*, Mallards *Anser platyrhynchos*, Moorhens *Gallinula chloropus* and a range of small birds. A number of these may breed.

Moorhens nest on most lowland forest ponds. (Gordon McCall)

3.5 Mammals (medium importance)

Larger forest ponds, especially where they connect to watercourses, are used by aquatic mammals such as Otters *Lutra lutra*, Water Voles *Arvicola terrestris* and Water Shrews *Neomys fodiens*. They are also used by terrestrial mammals for drinking.

3.6 Non-flowering Plants (medium importance)

Aquatic algae form the basis of most pond food chains, but have been little studied in Dumfries & Galloway. A number of aquatic and semi-aquatic mosses and liverworts also grow in ponds, and muddy pond edges tend to be most important for such species.

3.7 Fishes (low importance)

Though many forest ponds support fish populations, and some have been deliberately stocked, few of these are of conservation importance. The introduction of fish may seriously damage amphibian and invertebrate populations.

4. Environmental, Economic & Social Importance of Biodiversity

- Forest ponds contribute to local landscapes and provide a focal point on forest walks.
- Accessible forest ponds have high educational value.
- Correctly designed, located and constructed ponds can assist with the treatment of pollutants from forest quarries or roads.

5. Factors affecting the Habitat

- Damage during forest operations can result from **vehicle use, run-off or large amounts of brash or other debris** falling into the pond. Such damage is now usually avoided through detailed planning of forest operations.
- A **perception that forest ponds need to be regularly 'cleaned'** can result in damage.
- **Introduction of fish** into fishless ponds has occurred in ponds valuable for dragonflies. Such action is now illegal.

6. Strategic Actions

6.1 Recent and current activity

- A pond at Kirroughtree Forest Visitor Centre not only adds to visitor interest, but has been constructed by **Forestry Commission Scotland** and **Cree Valley Community Woodlands Trust** with platforms to enable educational groups to safely sample the aquatic life.
- Eskrigg, within Turnmuir Plantation at Lockerbie, is a former curling pond that is now managed as a nature reserve by the **Lockerbie Wildlife Trust**.
- Garrochar Ponds have been created on the site of a former curling pond within the Forestry Commission's Balloch Wood at Creetown. Though managed by the **Balloch Community Woods** group primarily for amenity purposes, they have quickly become of high biodiversity value.
- Contaminated groundwater (Acid Mine Discharge) issuing from the forest quarry at Craigenbay has been successfully treated by **Forestry Commission Scotland** using a series of four ponds that have a natural appearance and also make a positive contribution to wildlife.
- A number of forest ponds have been surveyed for their dragonfly populations.

6.2 Other recommended actions

- Carry out further **pond surveys to identify ponds of high biodiversity value**. Species groups likely to benefit from additional survey effort include dragonflies, water beetles, aquatic bugs, amphibians and aquatic plants.

SHORT-ROTATION COPPICE

Priority Action (SRC1)

Ensure that all grant-aided short-rotation coppice in Dumfries & Galloway is not located on or adjacent to sites important for Local Priority Habitats or Species, where there is likely to be a significant detrimental impact on biodiversity.
Lead: Forestry Commission Scotland/Regional Priority Assessment Committee.

Short-rotation coppice at Barrasgate Farm, Cummertrees, August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Short-rotation coppice is a highly specialised form of broadleaved plantation, designed to produce dense stands of fast-growing trees for use as wood chip fuel in biomass power stations. The species used are usually non-native, sterile willows that are planted in fields and harvested on rotations of 3 to 5 years when 7-8 metres high. The cut willows then regrow and can produce 8-10 crops over 25-30 years before the plot needs to be replanted. Poplars are also suitable, but are much less commonly used than willows.

Short-rotation coppice can be grown on most land and soil types, but it produces larger yields and is more economical to grow in the more fertile, larger fields of lowland areas. Although intensive soil preparation and herbicide use may be required during the establishment period, subsequent inputs are usually low. Mechanical harvesting takes place only in the winter months (November to March). **Headlands** are normally required for the harvesting machinery to operate, providing opportunities to manage these areas differently to the main crop. They tend to be wider and less susceptible to chemical drift than those around arable crops.

1.2 National and International Context

A number of European countries, especially in Scandinavia, have a longer history and more extensive areas of short rotation coppice than the UK.

2. Dumfries & Galloway Status

2.1 Recent Trends

Encouraged by government, interest in short-rotation coppice has been rapid since around 2005, when the first crops were established. Since then, the opening of a biomass power station at Lockerbie in 2007 has provided much of the impetus for the establishment of short-rotation coppice in the region. The area planted has been increasing and this is likely to continue in the foreseeable future, with a target of 4,000ha in Dumfries & Galloway and Cumbria by 2012.

2.2 Current Distribution

Most of the short rotation coppice planted to date is within a 50-mile radius of the power station at Lockerbie. Fields tend to be scattered on various farms within this area, though a minimum extent of 10ha per farm is preferred. A few areas have been planted beyond this radius.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with short-rotation coppice, and the following action plans may also contain relevant information: Agriculturally Improved Grasslands, Arable Fields, Traditional Field Boundaries.

3. Importance for Associated Species

3.1 Birds (medium importance)

Once established, Short-rotation coppice plantations rapidly develop into a scrub habitat, and attract a different bird community from arable and grassland on which they are usually planted. Finches, thrushes, tits and warblers are all likely to be more abundant than in adjacent arable or grassland fields. Migrant warblers are especially common, especially Willow Warblers *Phylloscopus trochilus*.

Birds associated with open farmland, such geese, Lapwings *Vanellus vanellus*, Golden Plovers *Pluvialis apricaria*, and Skylarks *Pluvialis apricaria* can be displaced by planting, but in winter Snipe *Gallinago gallinago* and Woodcocks *Scolopax rusticola,* prefer short rotation coppice crops to arable and grass fields nearby. Recently planted or cut short rotation coppice can also temporarily support Skylarks and Lapwings.

Several species of small bird, such as Dunnocks, nest in short rotation willows. (Gavin Chambers)

3.2 Invertebrates (medium importance)

As it matures the willow **canopy** attracts a diverse insect fauna. Bugs *Hemiptera* and beetles *Coleoptera* are most abundant, However, Blue Willow Beetle *Phyllodecta vulgatissima* is the major insect pest of coppice willow and spraying for this species can harm beneficial invertebrates. The sheltered **headlands** of mature crops attract butterflies in greater numbers than surrounding arable and grassland fields, especially whites, Meadow Browns *Maniola jurtina*, Small Tortoiseshells *Aglais urticae* and Peacocks *Inachis io*. These are generalist species – few specialists have been recorded.

Peacock butterfly, one of the species that benefit from wide headlands.(Peter Norman)

3.3 Mammals (medium importance)

Little research has been carried out on small mammal populations, but plantations with a dense ground cover are likely to support large numbers of mice and voles, and their mammalian predators. Rabbits and deer are excluded from plantations where they may pose a problem during the establishment phase.

3.4 Flowering Plants (low importance)

Recently planted or harvested short rotation coppice is dominated by annual plants, such as Groundsel *Senecio vulgaris*, Fat Hen *Chenopodium album* and Creeping Thistle *Cirsium arvense*. With growth, the proportion of annuals declines and perennials increase. The number of different plant species also increases as the crop grows, especially at edge. However, few scarce or threatened species have so far been recorded.

3.5 Fungi and Lichens (low importance)

Rust caused by a number of fungi called *Melampsora* is the most important disease of short rotation coppice. No species of high conservation value are known to favour this habitat.

3.6/3.7 Non-flowering Plants & Reptiles and Amphibians

Little research has been so far carried out on the importance of short rotation coppice for the above species groups.

4. Environmental, Economic & Social Importance of Biodiversity

- Short rotation coppice has very low net carbon emissions.
- Short rotation coppice and well managed conservation headlands can provide cover and food for game birds such as pheasants.
- Correctly sited and designed, short rotation coppice can enhance the landscape.

5. Factors affecting the Habitat

The recent creation of this habitat and its limited extent to date means that few land managers and their advisors are familiar with good practice for maximising biodiversity potential.

6. Strategic Actions

6.1 Recent and current activity

- Advice and grants are available from **Forestry Commission Scotland**.

6.2 Other recommended actions

- **Do not provide grants and incentives for short rotation coppice on land of high conservation value** for species associated with open ground.
- **Carry out research** into the management of headlands to increase the natural predators of Willow Beetle and reduce the need for intensive spraying.

AGRICULTURALLY IMPROVED GRASSLANDS

Priority Action (AGG1)

Increase biodiversity around the perimeter of improved grassland fields by providing and publicising a range of sites to demonstrate best practice.
Lead Partner: Regional Proposal Assessment Committee/Scottish Agricultural College.

Improved grassland landscapes are bright green, even in winter. Goldilea, April 2006.(Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Agriculturally improved grasslands have been heavily modified through drainage, fertiliser, slurry and pesticide application and reseeding. Fertiliser use in particular stimulates the growth of competitive grasses and a small number of common broadleaved plants such as docks at the expense of other plants. This results in the dominance of a very narrow range of plant species, often consisting almost exclusively of rye grasses and clover.

Agriculturally improved grasslands are managed either for silage (animal fodder that is made by storing green plant material that is preserved by partial fermentation), hay (animal fodder that is made by storing dried plant material) or grazing, most frequently by cattle and/or sheep. Stock is excluded from silage and hay fields during the main growing season, but they are usually grazed at other times. Leys are improved grass fields that are temporary, being ploughed and reseeded or put to another use every few years.

Most agriculturally improved fields are surrounded by a stockproof barrier, usually a wire fence but this is sometimes combined with a hedgerow or a drystone dyke. Those fields in low lying areas or prone to waterlogging often have a surrounding open **ditch** that may, or may not, be linked into an artificial underground drainage network in the field.

1.2 National and International Context

In the past 60 years agriculturally improved grassland in the UK has increased by approximately 90% in area. In 2006 there were approximately 1,244,000ha of agriculturally improved grassland in Scotland, of which 322,000ha were under 5 years old and 922,000ha more than 5 years old. In Dumfries & Galloway, the respective areas were 48,000ha and 166,000ha. In 2006 there were approximately 432,000 cattle (roughly 45% dairy/55% beef) and 1,108,000 sheep in Dumfries & Galloway, representing almost a third of Scotland's total dairy herd, 15% of breeding sheep and an important element of the beef sector. There is a much smaller, but increasing number of horses (2,650 in 2006).

2. Dumfries & Galloway Status

2.1 Recent Trends

The conversion of semi-natural grassland and wetland to improved grassland has dramatically slowed in the last decade or two, but has not stopped entirely. There has also been an increase in the number of species used in seed mixtures, with 100% Rye Grass now uncommon, and more targeted use of pesticides.

2.2 Current Distribution

Agriculturally improved grassland is the most common habitat in Dumfries & Galloway. Three quarters of all land in the region is farmed and the majority of this is improved grassland, managed either as pasture or silage. Most of this is in the lowlands, particularly the Rhins, Machars and Solway plain, but there are also many examples of improved grasslands in the upland fringe.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with agriculturally improved grasslands, and the following action plans may also contain relevant information: Neutral Grasslands, Acid Grasslands, Marshes, Lowland Burns and Ditches, Arable Fields, Traditional Field Boundaries, Wood Pastures and Parklands.

3. Importance for Associated Species

3.1 Birds (high importance)

Few birds nest on improved grassland. Lapwings *Vanellus vanellus* may occasionally do so, though this is usually limited to semi-improved pastures in the upland fringe; densely stocked lowland pastures and silage fields are rarely used.

A wider range of species, including thrushes, Pied Wagtails *Motacilla alba*, Rooks *Corvus frugilegus* and Starlings *Sturnus vulgaris*, feed on invertebrates in agriculturally improved grasslands. The local decline, to virtual extinction, of Choughs *Pyrrhocorax pyrrhocorax* is probably linked to the loss of grassland invertebrates, especially those associated with dung.

In improved pastures, Rooks feed on soil invertebrates such as leatherjackets. (Gavin Chambers)

In winter a relatively small number of fields, usually the same ones each year, are used by feeding geese and swans, including Whooper Swans *Cygnus cygnus,* Barnacle Geese *Branta leucopsis,* Greenland White-fronted Geese *Anser albifrons flavirostris,* Greylag Geese *Anser anser* and Pink-footed Geese *Anser brachyrhynchus.* For some of these species, such as Greenland Whitefronted Geese, there is evidence to suggest that the switch from feeding on semi-natural grasslands to agriculturally improved grasslands has occurred quite recently, possibly due to a reduction in semi-natural grasslands. All feeding species prefer short grass.

The edges of **ditches** are particularly valuable feeding areas for species such as Lapwings, Starlings and others.

3.2 Mammals (medium importance)

Rabbit (Paul McLaughlin)

Moles *Talpa europaea* are found wherever the soil is deep enough for them to burrow and feed primarily on earthworms. They are affected by deep ploughing. *Rabbits Oryctolagus cuniculus* and Badgers *Meles meles* also commonly feed in improved pastures. The decline of Brown Hares *Lepus europaeus* may be related to the increased use of chemicals and machinery on improved grassland, but loss of mixed farms and increased stocking rates may also have had an impact (hares are known to avoid heavily stocked fields). However conclusive evidence for any of these theories is lacking.

3.3 Invertebrates (low importance)

Species diversity of invertebrates in improved grassland is poor, but there may be high numbers of some invertebrates, including earthworms, ground beetles and cranefly larvae. Some flies, beetles and other invertebrates are associated with dung, and provide food for birds and bats. **Ditches** can be very valuable for a wide range of invertebrates, but only where there is permanent or regular flowing or standing clean water.

3.4 Reptiles and Amphibians (low importance)

No species of reptile or amphibian regularly uses agriculturally improved grasslands, unless they are in close proximity to more suitable habitats.

3.5 Fungi and Lichens (low importance)

Few fungi grow in improved grasslands, but field mushrooms *Agaricus spp*. and Brown Mottlegill *Panaeolina foenisecii,* which is stimulated by mowing, can occasionally be found. Harvested and bagged silage provides an unusual fungal habitat with the first

Scottish record of Split-gill *Schizophyllum commune* coming from near Stranraer in the 1960s. This is an uncommon deadwood species of southern England, but is now recorded breaking out through the polythene of silage bails.

Coprobia sp. fungus on dung. Crichope, June 2007. (Peter Norman)

3.6 Flowering Plants (low importance)

Agriculturally improved grasslands are dominated by a small number of highly productive grass species, sometimes grown with White Clover *Trifolium repens*. A few species, such as sorrels, may remain in semi-improved grasslands, and **ditches** may support species not found in the middle of the field.

3.7 Non-flowering Plants (low importance)

Intensively managed agriculturally improved grasslands have few, if any, non-flowering plants.

4. Environmental, Economic & Social Importance of Biodiversity

The large flocks of wintering swans and geese that feed on agriculturally improved grasslands are one of the wildlife spectacles of Dumfries & Galloway, and attract many visiting birdwatchers. They do, however, cause localised agricultural damage to fields.

5. Factors affecting the Habitat

- There has been a **move away from hay production** with lower inputs and greater species diversity to re-seeded rye grass silage with higher chemical inputs.
- **Local stock breeds are used less**, which may affect sward composition.
- A number of **avermectin-based veterinary medicines** are used to control internal worms and other parasites. Stock treated with these products excrete residues for several weeks, adversely affecting invertebrates and fungi associated with dung.
- **Careless application or spillage of chemicals, slurry and silage effluent** can affect habitats such as wetlands and watercourses by changing their nutrient status.
- **Slurry may be toxic** to soil invertebrates such as earthworms.
- **Waterlogging** reduces invertebrate populations.

6. Strategic Actions

6.1 Recent and current activity

- Goose management schemes, managed by Scottish Natural Heritage, operated in parts of the region most affected by goose grazing. These have now been incorporated into the Scottish Rural Development Programme.
- The Scottish Agricultural College has completed research that highlights the value of conservation headlands in grassland, as well as their more usual location in arable fields.
- There have been attempts to convert improved grassland to habitats closer to semi-natural types, including flower-rich grassland, heathland or woodland. So far these have been relatively small scale experiments, and there have been few in Dumfries & Galloway.

6.2 Other recommended actions

- Encourage adoption of a range of measures, including management of traditional field boundaries, to improve the biodiversity of field margins.

ARABLE FIELDS

Priority Action (AF1)

Provide advice for farmers and their advisors on improving arable fields for biodiversity, through training courses and establishment of a demonstration site.
Lead Partner: Farming & Wildlife Advisory Group.

Barley field Powfoot, July 2006. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Cereals, root crops, rape and maize are typical arable species. These may be grown either for human consumption or for animal fodder. **Unharvested crops**, including legumes, brassicas and linseed, have recently been introduced on some farms entirely for biodiversity and/or game purposes. For the purposes of this plan, grassland under 5 years old is not considered as arable, and is included in a separate agriculturally improved grassland action plan.

The value of arable fields for biodiversity is dependent on a number of factors. The **crop species** has a significant direct influence with some invertebrates associated with particular species. Perhaps of greater importance is the height and density of the **standing crop**. This affects the degree of shading and the wind speed, and therefore the humidity and temperature within the crop and at the soil surface. Crop height and density also influences the amount of space available for wildlife to grow or to move through the crop. These factors change at different stages of growth, and therefore the timing of cultivation, sowing and harvesting is critical. **Overwintered stubble** provides space, light and food for a range of wildlife.

Field margins have less competition from the crop, and are influenced by adjacent habitats such as hedges and woods. On arable farmland **ditches** need to have a water level well below the ground level in order to keep the surrounding land dry. They are therefore often deep and steep sided.

1.2 National and International Context

There was around 600,000ha. of arable land in Scotland in 2006. The extent in Dumfries & Galloway was small in comparison, at around 21,000ha.

2. Dumfries & Galloway Status

2.1 Recent Trends

Over the last 10-20 years, the area of arable land in Dumfries & Galloway has continued to decline. However, new methods have been developed to enhance biodiversity in arable fields with minimum loss of biodiversity. Farmers have been encouraged to adopt such techniques largely through incentives in agri-environment schemes.

2.2 Current Distribution

Most arable fields are located in the Stranraer basin, lower Nithsdale and lower Annandale. In 2006, arable crops in Dumfries & Galloway consisted of:
1632ha. wheat on 105 farms
11992ha. of barley (73% spring, 27% winter) on 572 farms
583ha. of oats (77% spring, 23% winter) on 70 farms
302ha. of oilseed rape (winter) on 15 farms
415ha. of potatoes on 57 farms
392ha. of turnips, swedes & fodder beet on 80 farms
186ha. of kale & cabbage on 45 farms
3379ha. of other crops (mostly maize) on 319 farms
1786ha. of set aside on 269 farms

2.3 Site Examples

At **Mersehead**, RSPB have introduced a range of measures that have dramatically increased bird numbers on arable land.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with arable fields, and the following action plans may also contain relevant information: Agriculturally Improved Grasslands, Traditional Field Boundaries.

3. Importance for Associated Species

3.1 Birds (high importance)

Few birds nest in mature **standing crops**, although Quails *Coturnix coturnix* and Marsh Harriers *Circus aeruginosus* are rare exceptions. Species such as Lapwings *Vanellus vanellus* and Oystercatchers *Haematopus ostralegus* use spring-sown cereals, but not autumn/winter sown crops that are too high at nesting time. Skylarks *Alauda arvensis* also nest in standing crops, but only up to a maximum crop height of around 30cm.

Tree Sparrows have declined as a result of the loss of arable fields. (Steven Round)

Grey Partridges *Perdix perdix* require long grass for nesting and abundant invertebrate food for their chicks. They therefore tend to nest on **field margins** but feed on invertebrates within the standing crop and on winter stubbles.

Standing crops are visited for food by birds such as Tree Sparrows *Passer montanus* nesting in adjacent habitats. However, arable fields become most valuable for seed-eating species such as Linnets *Carduelis cannabina,* Corn Buntings *Miliaria calandra* and Yellowhammers *Emberiza citronella* at harvesting time and in the months following. **Overwintered stubble** is especially valuable, not only for spilt grain, but for the seeds of weed species. Roosting Golden Plovers *Pluvialis apricaria* may also use winter stubble fields, but flocks have reduced dramatically in recent years due to the loss of such fields.

Corn Spurrey, a plant introduced to Britain with early farming but now in decline. Near New Abbey, July 2007. (Peter Norman)

3.2 Flowering Plants (high importance)

Flowering plants of arable fields are mostly annuals, adapted to quickly exploit bare ground, making use of conditions that are free of competition and shade. Most of them germinate in the spring, and therefore not in autumn/winter sown cereals. They include some of the rarest plants in Britain. In Dumfries & Galloway there is a long list of such species that are now either believed extinct or are very rare in the wild. They include Prickly Poppy *Papaver argemone,* Purple Ramping-fumitory *Fumaria purpurea,* White Mustard *Sinapis alba,* Field Pepperwort *Lepidium campestre*, Cornfield Knotgrass *Polygonum rurivagum*, Field Woundwort *Stachys arvensis*, Cornflower *Centaurea cyanus* and Rye Brome *Bromus secalinus*.

3.3 Non-flowering Plants (medium importance)

A specialised moss and liverwort flora has recently been discovered in arable fields, though the species concerned are generally small and inconspicuous. Intensively managed fields may have none of these at all, but fields those managed less intensively, particularly those with **overwintered stubble**, can be rich. Although some arable bryophytes, such as Glaucous Crystalwort *Riccia glauca* have been recorded in Dumfries & Galloway, the number and extent of important sites is not known.

3.4 Mammals (medium importance)

Brown Hares *Lepus europaeus* fare better on farms with arable fields, than those without – the crop providing cover for leverets, but without the intensity of cutting of silage fields. They particularly avoid heavily stocked pastures. Dumfries & Galloway is the only part of Scotland to support Harvest Mice *Micromys minutus*, but so far they have only been found in wetlands and rough grasslands, rather than the arable fields after which they were named.

3.5 Invertebrates (medium importance)

A large number of money spiders, hoverflies and ground beetles, such as *Bembidion lampros,* occur in arable fields, many of which assist with pest control. Bumblebees are important pollinators of many crops, but also require nectar and pollen from wild plants when the crop is not flowering. Well-managed **field margins** support few rare invertebrates but very large numbers of common ones, including butterflies, grasshoppers and plant bugs.

3.6 Fungi and Lichens (low importance)

Few fungi of conservation importance occur. Crop pests such as mildews and poisonous species such as ergots are effectively controlled by modern techniques.

4. Environmental, Economic & Social Importance of Biodiversity

Traditionally managed arable fields with wide field margins, wild flowers and overwintered stubble make a significant contribution to arable landscapes that can otherwise appear monotonous. Extensive arable landscapes are rare in Dumfries & Galloway; rather individual fields contribute to a 'patchwork' landscape.

5. Factors affecting the Habitat

- The **decline of mixed farming**, with arable fields, has reduced and fragmented populations of species associated with these habitats.
- A widespread **move to autumn-sown cereals** has made many fields unsuitable for many nesting birds and wild plants.
- Loss of traditional cropping systems, and associated **loss of winter stubble**, has reduced winter food sources for many farmland birds.
- Cropping systems have become more uniform with **less rotation** giving fragmentation and reduced habitat variety.
- The **use of insecticides, fungicides and herbicides** may cause significant harm to non-target species, even at less than the recommended application rate.
- **Aerial drift of chemicals** may result in impacts outside of the cropped area, such as field margins and ponds.
- **Seed treatment** may impact on seed-eating birds if some seeds are left unburied at sowing.
- **Fertilisers** greatly encourage modern crops and a small number of weed species, but these plants then out-compete wild plants.

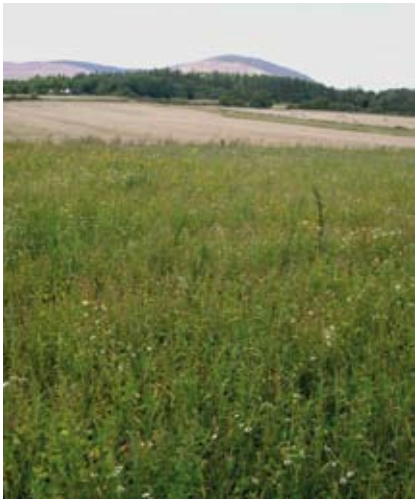
6. Strategic Actions

6.1 Recent and current activity

- Agri-environment schemes provide incentives to enhance arable fields.
- **Scottish Natural Heritage's** Targeted Inputs for a Better Rural Environment (TIBRE) project provides information to show how technology can be used in farming to benefit the environment.
- A Farmland Birds Working Group, organised by **RSPB**, meets to co-ordinate survey and management projects across the region.
- The **Game and Wildlife Conservation Trust** is undertaking a research project called Sustainable Arable Farming for an Improved Environment, which aims to enhance farmland biodiversity by developing more wildlife-friendly farming techniques.

6.2 Other recommended actions

- **Encourage the uptake of agri-environment schemes** to enhance the biodiversity of arable fields.
- **Improve awareness and training** in the practical techniques, such as headlands and beetlebanks, that can be used to enhance arable fields.



Wide arable field margins Arbigland, August 2006. (Peter Norman)

TRADITIONAL FIELD BOUNDARIES

Priority Action (TFB1)

Increase the quality of hedgerows, including hedgerow trees, in Dumfries & Galloway.
Lead Partner: Regional Proposal Assessment Committee.

Priority Action (TFB2)

Carry out research into the biodiversity of drystone dykes and their management.
Lead Partner: Scottish Agricultural College.

Drystone sheep pens, Queensberry (Richard Mearns)

1. Habitat Description

1.1 Physical Characteristics

Hedges are typically composed of Hawthorn, but many other shrubs, including Blackthorn, Elder, Holly, Beech, Hazel, Privet, Dog Rose and Gorse can also form hedges. Large hedges with a dense, bushy stock-proof structure offer an 'interior' as well as an 'edge' habitat to many species, with a slightly different microclimate. **Hedge banks** are hedges planted on earth mounds, sometimes mixed or faced with stones. **Hedgerow trees**, typically Ash, Wych Elm and oaks, provide additional structure to hedges. On some farms, they may be the single most important wildlife habitat.

Drystone walls, better known locally as **drystone dykes**, are the dominant field boundaries where rocky outcrops are common, the soil is thin and the climate is too harsh for hedgerows. But some lowland, more fertile areas also have dykes. In both environments they fulfil the similar functions for wildlife as a hedge. Individual trees can also occur within the line of drystone walls.

Drystone dykes take a variety of forms depending on local tradition and availability of materials. The standard and commonest form consists of two separate dyke faces with small stones in-between and throughstones and topstones bridging the two faces together. They are constructed from a variety of materials, often quarried sedimentary stone such as sandstone, limestone or greywacke. Single dykes, where most of the stones are very large boulders in a single wall, form only a small proportion of all dykes but can be very common in some localities, including parts of Galloway. They are almost invariably built of field clearance stone as opposed to quarried material, and the rock type is usually igneous, especially granite. There is usually an exposed, wet side to a dyke and a dryer, warmer side. The top is windswept but the bottom sheltered. Inside it can be dry and sheltered, perhaps with a trickle of water.

Red sandstone dyke at Crichope Linn, June 2007. (Peter Norman)

The bases of hedges and dykes are usually well sheltered with higher daytime temperatures and humidity than the field, and they are often relatively undisturbed by agricultural activities. Some may suffer from nutrient enrichment from adjacent roads and tracks, or fertiliser drift. **Hedge-bottoms** often have a woodland flora, whilst **dyke-bases** are usually more weedy.

1.2 National and International Context

Hedges and walls are not especially British; they occur in many forms as far away as South America, but there are few countries where they form such an integral part of the landscape as in Britain. It would be difficult to find many parts of the country where one or the other did not form part of the view. Galloway single dykes are the most locally distinctive boundary type, though similar structures are found in other parts

of Scotland, Wales, northern England and Dartmoor. There is approximately 814,000km of hedgerows in the UK, 48,700 of which are in Scotland, and approximately 87,500km of walls in Scotland. These figures compare with more than 235,000 of fences in Scotland.

Hedgelaying training course at Bombie Farm, Kirkcudbright, January 2005.(FWAG)

2. Dumfries & Galloway Status

2.1 Recent Trends

Whilst deliberate destruction of field boundaries has virtually ceased in the last 30 years, the fortunes of hedgerows and drystone dykes has varied enormously in this period. Many dykes have been rebuilt along their original lines. There are also examples of successful hedgerow restoration projects, but this has had a minimal impact on the scale of the problem. The vast majority of the region's hedgerows remain in an extremely poor condition, unmanaged other than by an annual flail with a tractor-driven machine, and continuing to slowly disappear from existence. Virtually none of them are stockproof without the need for additional fencing.

2.2 Current Distribution

Hedgerows and dykes are widespread throughout the region, though hedgerows are predominantly lowland in distribution. Hedge banks are rare.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with traditional field boundaries, and the following action plans may also contain relevant information: Veteran Trees, Agriculturally Improved Grasslands, Arable Fields, Roads and Verges.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Many invertebrates are associated with traditional field boundaries, though few, if any, require maintenance of the boundary in a stockproof condition. The number of invertebrates associated with **hedgerows** probably runs into many thousands. Typical moths include Early Moth *Theria primaria*, Chinese Character *Cilix glaucata* and Green-brindled Crescent *Allophyes oxyacanthae.* The caterpillars of the Orchard Ermine moth *Yponomeuta padella* live gregariously in webs on Hawthorn and Blackthorn hedges and can defoliate long stretches. The Bird Cherry Ermine *Yponomeuta evonymella* may do the same where Bird Cherry occurs in hedges, though in both cases the host plant always recovers. Many bees, wasps, sawflies, mirid bugs, shield bugs, leaf beetles are also to be found.

A myriad of invertebrates and their eggs are found in **drystone dykes** - spiders, woodlice, springtails, millipedes, bees and wasps. The rare Wall Mason Bee *Osmia parietina*, typically associated with drystone walls, has been recorded in two locations on the Solway coast (out of less than 20 in the UK), whilst the even rarer ruby-tailed wasp *Chrysura hirsuta*, usually found in pastures with dykes, has been recorded in the region just once, near Whithorn in 1973. A spider *Textrix denticulata* is often found amongst stone dykes, whilst the Muslin Footman moth *Nudaria mundana* feeds on lichens growing on dykes and other rocks.

The nationally rare Wall Whorl Snail *Vertigo pusilla* is most typically found at ivy-covered **dyke-bases**, usually shaded by trees. The weedy flora of dyke-bases can also be important for some butterflies, including Nettle-feeding Peacocks *Inachis io* and Small Tortoiseshells *Aglais urticae.*

3.2 Birds (high importance)

Well-maintained bushy **hedgerows** can provide food and nest sites for many species of small bird, including Linnets *Carduelis cannabina* and Yellowhammers *Emberiza*

Dunnock, sometimes called Hedge Sparrow (Paul McLaughlin)

citronella, whilst Grey Partridges *Perdix perdix* often nest in **hedge bottoms**. Hedgerow trees add further structure to the habitat and are used by nesting Tree sparrows *Passer montanus,* Barn Owls *Tyto alba and other species.*

Dykes are of lesser importance for birds, but some species such as Wrens *Troglodytes troglodytes*, and in the uplands Wheatears *Oenanthe oenanthe*, may nest in cavities within them.

3.3 Flowering Plants (high importance)

Hawthorn *Crataegus monogyna* is by far the most abundant **hedgerow** plant, though in Dumfriesshire there are also many Beech *Fagus sylvatica* hedges. Other shrubs that are often part of the hedge, and in some cases can be the dominant species, include Blackthorn *Prunus spinosa*, Gorse *Ulex europaeus*, Holly *Ilex aquifolium*, Elder *Sambucus nigra,* Wild Privet *Ligustrum vulgare* and Guelder Rose *Viburnum opulus*. A feature of many parts of Dumfries & Galloway in the spring are the great drifts of Cow Parsley at **hedge-bottoms**. In other areas there is more of a woodland flora with Primroses *Primula vulgaris*, Bluebells *Hyacinthoides non-scripta* and even Early Purple Orchids *Orchis mascula*.

A number of plants grow on **drystone dykes**, including cranesbills and stonecrops.

3.4 Fungi and Lichens (high importance)

Lichens generally favour the exposed side of **dykes**, leaving the damper sheltered side to the mosses. Where stock rubs against the dyke, the lichen flora may be limited to a few species able to cope with this.

Hedgerow trees are very important for lichens. They support species not found in woodlands; instead rather approaching the diversity of those of wood pastures. However, due to the abundance of hedgerows, in comparison to wood pastures, their total value may be greater. The species and age of the tree has a significant influence, but so to do local conditions and management. Elm is the prime host of the most threatened lichens, but Ash and Sycamore are also valuable. In areas with little native woodland, hedgerows may be the only significant habitat for epiphytic lichens.

3.5 Mammals (medium importance)

Bats use holes in **hedgerow trees** for breeding and roosting and will often fly along hedgerows when

Beech hedge at Claygate, near Canonbie, February 2008. (Peter Norman)

travelling between areas of semi-natural habitat. Most bats avoid from crossing open fields, and may even shun from crossing quite small gaps in hedges. Hedges can also form an important habitat component for other species, including of course Hedgehogs *Erinaceus europaeus.*

Voles, mice and shrews find shelter within **dykes**, where they are hunted by Stoats *Mustela erminea* and Weasels *Mustela nivalis*.

3.6 Non-flowering Plants (medium importance)

Shady, damp dykes can be totally covered in mosses and liverworts. Semi-derelict dykes in more exposed environments are colonised by Woolly Fringe-moss *Racomitrium languginosum.* Hedgerow trees, especially Ash, Sycamore and Wych Elm can be rich in mosses and liverworts, including the possibility of rare species.

3.7 Reptiles and Amphibians (medium importance)

Dykes are used for shelter and basking sites by Common Lizards *Zootoca vivipara* and Slow Worms *Anguis fragilis*. Newts, Common Frogs *Rana temporaria* and Common Toads *Bufo bufo* may also find shelter, perhaps even hibernation sites, within them.

4. Environmental, Economic & Social Importance of Biodiversity

- Hedges, boundary trees and dykes are highly significant features in most agricultural landscapes.
- Both hedges and dykes provide shelter for livestock and crops.

- The ground beetles, ladybirds and parasitic wasps that are associated with traditional field boundaries provide a biological control service that greatly outweighs the damage caused by the pests found in these habitats.

5. Factors affecting the Habitat

- There is a widespread perception that field hedgerows should look like garden hedges, neatly clipped and tidy. Unfortunately **mechanical flailing** can never produce the same results as garden shears.
- **Cutting hedges in the summer** destroys bird nests, and in the autumn prevents the formation of berries.
- The **loss of hedgerow trees** probably outnumbers the loss of the hedgerows themselves. Dutch Elm Disease has contributed to this loss, but management practices, including annual flailing, rarely favour their replacement.
- **Overstocking** of fields can lead to the loss of flowers and lichens associated with hedgerows, dykes and trees. Conversely, **loss of grazing** can lead to ivy encroachment, which has benefits for invertebrates, but can lead to loss of lichens.
- Well established, traditional field boundaries are often the first casualty of **road widening schemes**. Their replacements will take many decades to acquire the same biodiversity interest.

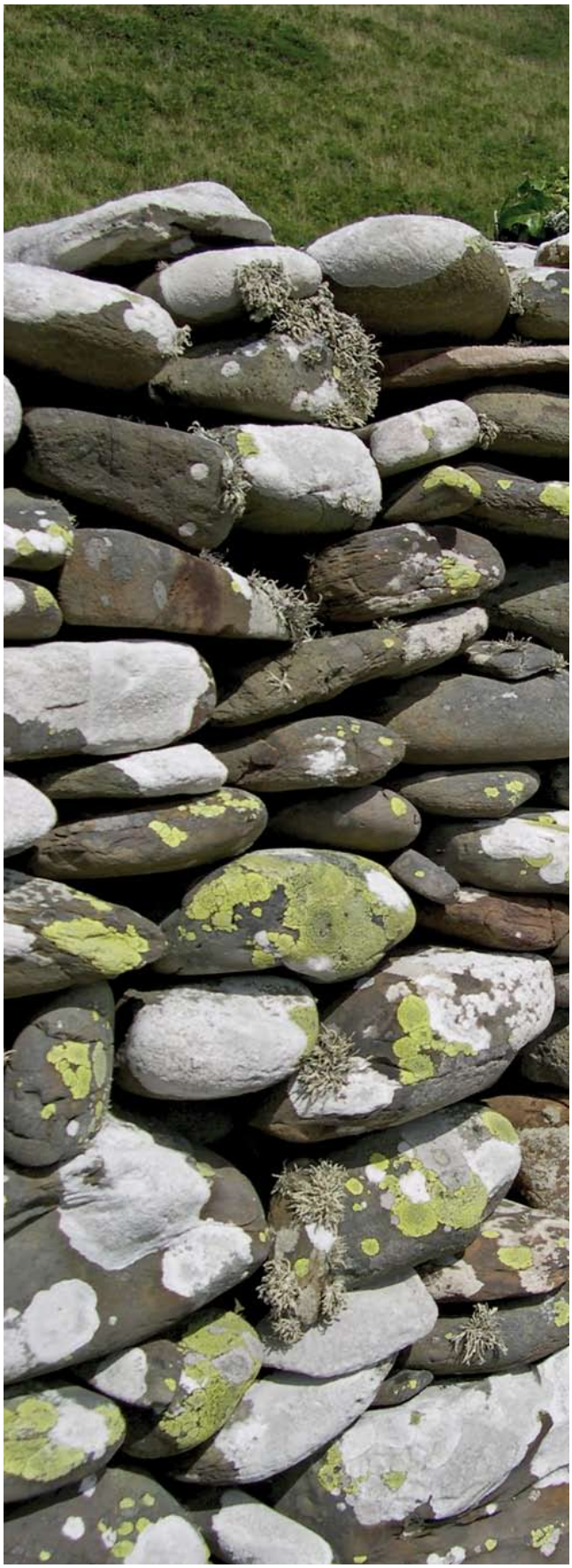
6. Strategic Actions

6.1 Recent and current activity

- Agri-environment schemes have funded the creation of new hedgerows.
- The **Farming and Wildlife Advisory Group** has promoted good practice in hedgerow management through advice, demonstrations and training events.

6.2 Other recommended actions

- Options are available for field boundaries as part of **Rural Development Contracts and Rural Priorities.**
- **Develop hedge management skills** through training and advice.



Lichen encrusted seashore stones in dyke at Claymoddie, Machars, August 2007. (Peter Norman)

WOOD PASTURES & PARKLANDS

Priority Action (WPP1)

Complete Sulwath Connections Wood Pasture project and secure funding to extend this work throughout the region.
Target: Dedicated wood pasture project to operate region-wide from 2008 to 2013.
Lead: Sulwath Connections.

Parkland at Shambellie, New Abbey, May 2004. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Wood pastures comprise of grazed grassland or heathland combined with trees or shrubs. Both elements of the habitat were traditionally managed for the production of both livestock and timber products, though management of trees is now rare. **Parklands** have the same vegetational structure as wood pastures but were deliberately designed, usually in the vicinity of a large house and sometimes superimposed over older wood pastures, primarily for landscape reasons.

Open-grown trees are characteristic of wood pastures and parklands. They differ from woodland trees in that they typically have rounded crowns, low heavy branching, basal swelling, fat trunks and many hollows. Some show evidence of previous pollarding, and many are now considered to be **veteran trees**.

Scrub is essential for high biodiversity in wood pastures and parklands. It not only supports numerous invertebrates and birds, but also provides protection from grazing to allow trees to regenerate.

The majority of wood pastures and parklands now have grassland that has been agriculturally improved through fertiliser and pesticide application, but **unimproved grassland** still occurs on some sites and is of high biodiversity value. Heathland under wood pasture is also of high biodiversity value, but is even rarer.

1.2 National and International Context

Wood pastures, in one form or another, exist in many European and other countries. However, the species composition and management techniques used in British wood pastures and parklands are unique, and few countries have such a long history of management. In particular, the number of veteran trees and the abundance of associated species in British wood pastures and parklands is outstanding, compared to their European counterparts.

2. Dumfries & Galloway Status

2.1 Recent Trends

The techniques of managing wood pastures were abandoned in the 19th and 20th centuries to such an extent that the very existence of this form of land management became almost totally forgotten. However, in the late 20th century there was a resurgence of interest in wood pastures, primarily for their biodiversity value, especially their veteran trees. In the last ten years there has been considerable research into new techniques to restore the remaining fragments of wood pastures, and consideration given to the creation of new ones. This has yet to have a significant impact in Dumfries & Galloway.

2.2 Current Distribution

The present distribution of wood pastures and parklands in Dumfries & Galloway has not been accurately assessed. Wood pastures occur in both the uplands and lowlands, whilst parklands are predominantly lowland. However, although both are widespread, neither is evenly distributed.

2.3 Site Examples

Lochwood (SSSI), near Beattock, is often quoted as the best wood pasture site in the region. Although the site has a history of wood pasture and contains one of

Short, stubby, veteran oaks. Boreland of Parton, July 2007. (Peter Norman)

the finest collections of veteran trees in Britain, most of it has not been managed as wood pasture for some time. There are, however, some very good examples of current wood pasture on its fringes and on nearby **Raehills Estate**. Other sites include **Boreland Hills** and **Ardwall Hill** in the Fleet Valley. Good examples of parklands are found at **Drumlanrig Castle** and at **Kirkconnell House** and **Shambellie House** near New Abbey.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with wood pastures and parklands, and the following action plans may also contain relevant information: Native Woods, Veteran Trees.

3. Importance for Associated Species

3.1 Fungi and Lichens (very high importance)

The combination of habitats in wood pastures means that they are important for a range of fungus species. On the **open-grown trees**, light and humidity conditions are often ideal for many lichen species. For example, Tree Lungwort *Lobaria pulmonaria* is known from several current and former wood pastures across the region. Other lichens, recorded only rarely in Dumfries & Galloway, that may benefit from enhancement of wood pastures include *Bacidia incompata*, *Schismatomma graphidioides* and Orange-fruited Elm Lichen *Caloplaca luteoalba.*

The presence of **veteran trees** also makes wood pastures important for a range of saproxylic fungi. The internationally rare Oak Polypore *Piptoporus quercinus* has been recorded at Lochwood, whilst other bracket fungi such as Beefsteak Fungus *Fistulina hepatica* and Hen of the Woods *Grifola frondosa* are more common species. Where it exists, **unimproved grassland** beneath the trees may also be important for grassland fungi such as waxcaps.

3.2 Invertebrates (very high importance)

Due to the presence of many **veteran trees**, many wood pastures are very important for invertebrates. Most of these are associated with decaying wood in veteran trees, but others feed on fungi and other invertebrates that are found on the trees. For example, the larvae of a nationally scarce darkling beetle *Eledona agricola* develops in the fruiting bodies of Sulphur Polypore *Laetiporus sulphureus*, and occasionally other bracket fungi, mostly in old wood pastures. Virtually no local surveys have been completed of such species.

However, the presence of many veteran trees is not the only reason why wood pastures are very important for invertebrates; those sites with **scrub**, especially Hawthorn and Blackthorn blossom, provide essential nectar for the adult insects that emerge from the trees. **Unimproved grassland** provides a nectar-rich habitat, but scrub and associated flowers such as Hogweed *Heracleum sphondylium* and other umbellifers are equally valuable within improved pastures.

3.3 Mammals (high importance)

Though many mammals, including Brown Hares *Lepus europaeus* and Badgers *Meles meles* undoubtedly make use of wood pastures, their greatest importance is for bats. **Veteran trees**, with their numerous holes and hollows, provide many opportunities for breeding roosts and hibernacula, whilst invertebrates associated with both the trees and **unimproved grassland** provide abundant food.

3.4 Non-flowering Plants (medium Importance)

Epiphytic ferns are usually abundant on **veteran trees** in wood pastures and parklands. Common Polypody *Polypodium vulgare* is the typical species, but others also occur. Veteran trees also provide an ideal habitat for epiphytic mosses and liverworts, though isolated trees are of less value, being susceptible to drying winds. Little work has been carried out in Dumfries & Galloway, but the local bryophyte flora may be better than in some of the 'classic' wood pasture sites in southern England, where air pollution is a restricting factor. Typical species include Park Yoke-moss *Zygodon rupestris* and Squirrel-tail Moss *Leucodon sciuroides.*

3.5 Birds (high importance)

Hole-nesting species that feed in open areas are the typical birds of wood pastures. These include Barn Owls *Tyto alba,* Redstarts *Phoenicurus phoenicurus* and Spotted Flycatchers *Muscicapa striata.* Areas of scrub may attract breeding Dunnocks *Prunella modularis* and Linnets *Carduelis cannabina.*

3.6 Flowering Plants (low importance)

Apart from their veteran trees, most wood pastures in the region tend to have improved or semi-improved grassland that supports a limited range of flowering plants. Crab Apples *Malus sylvestris* are a distinctive feature of many wood pastures in Dumfries & Galloway.

3.7 Reptiles and Amphibians (low importance)

The open conditions of wood pastures is of more benefit to reptiles and amphibians than dense woods. However, the trees alone are of little value without a field layer that provides shelter, invertebrate food and, in the case of amphibians, breeding ponds. Therefore, only those wood pastures with **unimproved grassland**, heathland or wetland tend to support high reptile and amphibian populations.

4. Environmental, Economic & Social Importance of Biodiversity

- Wood pastures and parklands are of considerable landscape value. In parklands, the combination of trees and pasture was deliberately planned to be pleasing to their owners, often when viewed from the windows of their homes, but even in non-designed wood pastures, the diversity of colours, shapes and light offered by this habitat forms an attractive landscape.
- Wood and scrub offers shelter for stock in winter and shade in summer. Some grazing of trees and shrubs may occur, but this is rarely managed in any way, although recent research has suggested that livestock might benefit from the supplementary feeding of tree foliage.
- Timber production would historically have been one of the uses of wood pastures. Some sites retain patches of high forest as well as open-grown trees and these can be thinned out to provide good timber.
- Many wood pastures illustrate past land use and are therefore part of the region's cultural heritage, providing evidence of how our ancestors lived and worked. Apart from the value of the trees themselves, many contain other features of cultural heritage value including earthworks, disused mines, rock carvings, a Neolithic burial cairn, a hill fort and a 12th century motte.

Scrub pastures, often dominated by Gorse, are common across the region. Lochanhead, April 2006. (Peter Norman)

5. Factors affecting the Habitat

- **Removal of trees** and dead wood through perceptions of safety and tidiness where sites have high amenity use, forest hygiene, the supply of firewood or vandalism.
- Loss of veteran trees through **disease, physiological stress such as drought and storm damage**, and competition for resources with surrounding younger trees.
- Damage to trees and roots from **soil compaction and erosion** caused by trampling of livestock and car parking.
- Neglect, and **loss of expertise** of traditional tree management techniques (e.g. pollarding) leading to trees collapsing or being felled for safety reasons.
- **Lack of regeneration** of trees, producing a skewed age structure, leading to breaks in the continuity of dead wood habitat and loss of specialised dependent species.
- Pasture improvement through **reseeding, deep ploughing, fertiliser and other chemical treatments**, leading variously to tree root damage, loss of nectar-bearing plants, damage to the soil and epiphytes.

White Galloway cattle grazing under Ash trees. High Ardwall, Gatehouse of Fleet, August 2005. (Peter Norman)

- **Inappropriate grazing levels**: under grazing leading to loss of habitat structure through bracken and scrub invasion; and over grazing leading to bark browsing, soil compaction and loss of nectar plants.
- **Pollution** derived either remotely from industry and traffic, or locally from agro-chemical application and nitrogen enrichment from pasture overstocking, causing damage to epiphyte communities and changes to soils.
- Wood pastures have been poorly served by **agri-environment and forestry grant schemes.**

6. Strategic Actions

6.1 Recent and current activity

- A preliminary assessment of the distribution and extent of the wood pasture resource in Dumfries & Galloway was commissioned by **Scottish Natural Heritage** in 2006.
- A detailed assessment of wood pastures in the Fleet Valley National Scenic Area, including history, management, vegetation and veteran trees was carried out in 2005 by **SEPA, Solway Heritage and Dumfries & Galloway Council**. An introductory booklet to wood pastures in Dumfries & Galloway was produced at the end of this project.
- A project to manage, and possibly create, wood pastures in selected locations in Dumfries & Galloway was begun in 2007 as part of the Heritage Lottery Funded **Sulwath Connections** Landscape Scheme.
- **RSPB** has begun to create a wood pasture (or, depending on definition, restore of a degraded one) at Barclye in the Cree Valley, with the support of Sulwath Connections.

6.2 Other recommended actions

- **Promote the positive features of grazing in woodland** and the role of wood pasture in planning ecological restoration.
- **Identify sites** with current or historical evidence of wood pasture. This does not mean that all such areas should be managed as wood pasture but its existence should be appreciated and the possibility of maintaining or enhancing wood-pasture features considered.
- Examine the feasibility of running **training courses** in traditional tree management techniques (e.g. pollarding).
- Explore possibilities for the **creation of new areas of wood pasture**.
- Encourage and contribute to the national production of an **illustrated management guide** to wood pasture and parkland.

FARM WOODS & SHELTERBELTS

Priority Action (FSB1)

Create new farm woods and shelterbelts on land currently of low biodiversity and archaeological interest.
Target: 50 new farm woods on appropriate sites by 2015.
Lead Partner: Regional Proposal Assessment Committee.

Priority Action (FSB2)

Improve the biodiversity management of existing farm woods and shelterbelts through provision of site-specific advice.
Lead Partner: Forestry Commission Scotland/Farming & Wildlife Advisory Group/Scottish Agricultural College.

Conifer and broadleaved farm shelterbelts at Dalswinton. (Richard Mearns).

1. Habitat Description

1.1 Physical Characteristics

Most woods on farms are small, usually less than 2 hectares. Unlike the larger commercial plantations, which are often managed by external agents primarily for timber production, most farm woods are managed as part of the day to day activities of the farm. They are often located close to farm buildings, but may also be found along access tracks and field boundaries. As a result, many are linear in shape.

Though predominantly of planted origin, farm woods and shelterbelts can be composed of native or exotic species, and can be used for a variety of purposes depending on their structure and location. Biodiversity interest tends to increase with the age of the wood, but even relatively young plantations have some value. Often the interface between farmland and woodland offers the greatest potential for biodiversity.

1.2 National and International Context

There were approximately 250,000ha of farm woodland in Scotland in 2006, of which around 16,000ha were found in Dumfries & Galloway.

2. Dumfries & Galloway Status

2.1 Recent Trends

Few farm woods have been deliberately removed in recent decades. However, with the exception of those that have been converted to conifers, most have not been managed to any extent. Trees that have fallen as a result of disease, storms or old age have usually been cleared but not replaced. Though new farm woods have been created in recent decades, these have not been numerous.

2.2 Current Distribution

Farm woods and shelterbelts are widespread across Dumfries & Galloway, though some areas, particularly in the lowlands, have a greater density of these woods than others. Farms that are, or were once, part of a large estate often have more farm woods.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with farm woods and shelterbelts, and the following action plans may also contain relevant information: Native Woods, Broadleaved and Mixed Plantations, Traditional Field Boundaries.

3. Importance for Associated Species

3.1 Birds (medium importance)

Farm woods are rarely large enough to support many woodland breeding birds, although a few common species are usually found. However, they can form important nesting sites for birds that feed elsewhere on the farm. Typical species include Rooks *Corvus frugilegus* and Starlings *Sturnus vulgaris* with Tree Sparrows *Passer montanus* in a few locations. Barn Owls *Tyto alba* may nest in farm woods if there are suitable holes or nest boxes. In exceptional cases,

they may also be used by Little Owls, on the northern edge of their range, or Long-eared Owls *Asio otus*, which avoid larger woods dominated by Tawny Owls *Strix aluco*.

Great Spotted Woodpeckers will nest in quite small woods if suitable deadwood is available. (Gordon McCall)

3.2 Mammals (medium importance)

Farm woods are valuable habitat features for bats. Old trees provide roost sites and the wood can be a valuable source of insect food, but even when this is not the case they provide valuable habitat linkages between areas of high insect abundance, such as wetlands, and roost sites in farm buildings. Many bat species will not cross open country.

3.3 Fungi and Lichens (medium importance)

A range of fungi can be found in farm woods, though there are none are restricted to this habitat. Such woods are of greater value to lichens, as their high ratio of edge habitat and often their open nature, provides environmental conditions closer to wood pasture than dense woodland. Also, the tree species typical of many farm woods in Dumfries & Galloway – Ash and Wych Elm, is well suited to many lichens.

3.4 Reptiles and Amphibians (medium importance)

Though farm woods in themselves may not be of high value for reptiles and amphibians, they are often an important component for a wider habitat mosaic for newts and Common Toads *Bufo bufo.*

3.5 Invertebrates (low importance)

The small size, open nature, limited range of tree species and lack of deadwood usually limits the value of farm woods for the rarer species of invertebrates. Nevertheless, such woods may contain an abundance of common species that may be rare elsewhere on the farm.

3.6 Flowering Plants (low importance)

As with invertebrates, the history and environmental conditions found in farm woods and shelterbelts, is rarely suitable for important flowering plants, but such sites may contain common species that may not be found elsewhere on the farm.

3.7 Non-flowering Plants (low importance)

The open nature of most farm woods makes them poor habitats for mosses and liverworts.

4. Environmental, Economic and Social Importance of Biodiversity

- The landscape value of farm woods and shelterbelts, both individually and collectively, is enormous. They can also screen unsightly buildings.
- Farm woods and shelterbelts act as buffers to increase farm biosecurity.
- Many small woods provide cover for pheasants and other game.
- Farm woods and shelterbelts reduce wind-borne soil erosion and help reduce both the amount and rate of run off into watercourses, thus contributing to flood alleviation.
- Footpaths and public access routes are often defined by farm woods, and they add interest for the visitor.

5. Factors affecting the Habitat

- **Dutch Elm Disease** has reduced the number of elms in farm woods and shelterbelts.
- Unmanaged **stock access** can damage ground flora and prevent regeneration.
- **Dead and fallen trees are usually cleared immediately**, often for firewood. This removes an important habitat for many species of bird, bat and invertebrate.
- Some woods are used to screen the dumping of **farm rubbish**.

Rookery at Kirkton. (Richard Mearns)

6. Strategic Actions

6.1 Recent and current activity

- Some farm woods have been fenced from livestock under agri-environment schemes.

6.2 Other recommended actions

- **Carefully plan new farm woods** to avoid habitats that are already of biodiversity interest, such as wetlands or unimproved grasslands, and archaeological sites. Maximise biodiversity and other benefits, by linking existing habitats, such as ponds and hedgerows.
- **Aim for several small woods** on the farm, especially when managing for game birds.
- Consider **reversion of conifer woods to broadleaved or mixed woods**. Small conifer plantations rarely have an economic value.

FARM PONDS

Priority Action (FP1)

Create new pond landscapes (several ponds linked by wildlife-rich habitats) in farmland areas known to support important pond species.
Lead Partner: Regional Proposal Assessment Committee.

Priority Action (FP2)

Provide training in the management of farm ponds.
Target: Arrange 2 training courses by 2012.
Lead Partner: Farming & Wildlife Advisory Group.

A recently created sustainable farm drainage pond at Barnboard Farm, Bridge of Dee, August 2006. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Natural ponds occur on farms, but the majority of farm ponds have been artificially created. They vary in size from puddles of one square metre to deep lochans of 1-2 hectares or more, but this variation adds to their value. The water can be permanent or seasonal. Many originally served a specific purpose in farm management, but the majority now only provide amenity, wildlife or sporting value.

Unlike many other habitats, there is little ecological difference between man-made and semi-natural ponds. Factors such as geology, water depth, exposure to pollution and location in the landscape are much more important than the origin of the pond.

New ponds have also recently been created for **Sustainable Farm Drainage Systems.** Such ponds are designed to treat and store runoff from farm steadings, to prevent damage to natural watercourses. They should, however, also provide biodiversity and amenity benefits.

1.2 National and International Context

Scotland is estimated to have at least 150,000 waterbodies up to 2ha, around half of the British total. Their number and extent in Dumfries & Galloway is unknown.

2. Dumfries & Galloway Status

2.1 Recent Trends

In the last few decades there has been a trend to create new farm ponds for angling, shooting, wildlife or amenity purposes. However this has not yet resulted in a pond density anywhere near that seen at the beginning of the 20th century. Indeed, on a UK scale the number of new ponds is estimated only to match those still being lost, although it is suspected that this is not the case in south west Scotland where there has been relatively little loss of farm ponds in recent years.

2.2 Current Distribution

Ponds are believed to be widespread in all farming areas across Dumfries & Galloway, but there has been little research into variations in pond density.

2.3 Site Examples

Carrick Ponds (SSSI) are some of the most important in Scotland for water beetles.
A network of farm ponds at **Burrow Head** (SAC/SSSI) forms one of the most important breeding areas in Britain for Great Crested Newts.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with farm ponds, and the following action plans may also contain relevant information: Eutrophic Lochs, Mesotrophic Lochs, Swamps, Marshes, Native Wet Woods, Forest Ponds.

3. Importance for Associated Species

3.1 Reptiles and Amphibians (very high importance)

Common Frogs *Rana temporaria*, Common Toads *Bufo bufo* and all three species of newt – Great Crested *Triturus cristatus*, Smooth *Lissotriton vulgaris* and Palmate *Lissotriton helvetica* regularly breed in farm ponds. Natterjack Toads *Epidalea calamita*, though of limited distribution, also breed in a few farm ponds.

Common Toads benefit from larger ponds. Kirkconnel, February 2006. (Greg Baillie)

3.2 Invertebrates (high importance)

Many aquatic invertebrates are found in farm ponds. Typical species include moths such as Bulrush Wainscots *Nonagria typhae* that feed on Reedmace, water beetles such as Great Diving Beetles *Dytiscus marginalis,* and dragonflies such as Large Red Damselflies *Pyrrhosoma nymphula.*

A number of locally important species have also been recorded from a few ponds in the region. These include Water Spiders *Argyroneta aquatica,* the only spider to live an almost entirely submerged existence, and Variable Damselflies *Coenagrion pulchellum* that have a restricted UK distribution.

3.3 Birds (high importance)

Mallards *Anser platyrhynchos* and Moorhens *Gallinula chloropus* are the typical breeding birds of farm ponds, with Sedge Warblers *Acrocephalus schoenobaenus* and Reed Buntings *Emberiza schoeniclus* in the surrounding marsh and scrub. However, farm ponds may be of critical importance in providing food for birds that may nest elsewhere on the farm, including Lapwings *Vanellus vanellus*, Redshanks *Tringa totanus* and Tree Sparrows *Passer montanus.*

3.4 Flowering Plants (medium importance)

A wide variety of flowering plants is found in farm ponds. Mudwort *Limosella aquatica,* an annual of the muddy edges of ponds, if found only erratically in Dumfries & Galloway. Lesser Reedmace *Typha angusifolia*, of restricted distribution in Scotland, grows in slightly deeper water on the edge of ponds than its larger and commoner relation.

3.5 Mammals (medium importance)

Larger farm ponds, especially where they connect to wetland, are used by aquatic mammals such as Otters *Lutra lutra*, Water Voles *Arvicola terrestris* and Water Shrews *Neomys fodiens*. They will also be used for drinking by terrestrial mammals.

3.6 Non-flowering Plants (low importance)

Algae are a natural part of ponds and form rich habitats for many invertebrates and the basis of many food chains. However nutrient enrichment can cause dense algal growth and blooms, to the detriment of other species.

3.7 Fishes (low importance)

Though farm ponds may be stocked with fish for angling or amenity purposes, the species involved are of low conservation importance. It is damaging, and potentially illegal, to stock ponds with fish that are currently fishless.

4. Environmental, Economic & Social Importance of Biodiversity

- Water creates a focal point in farm landscapes.
- Ponds have a cultural and archaeological value. Mill ponds and other farm ponds provide valuable information about the history of a place.
- Ponds may be of considerable amenity value: some are used for shooting or fishing, others for boating or part of a nature reserve.

5. Factors affecting the Habitat

- On a national scale, **pollution** may be more of a threat to ponds than actual loss. This includes nutrient over-enrichment (eutrophication) from fertiliser and slurry runoff and accidental chemical contamination.
- Excessive **cattle poaching** on the banks of

ponds can cause turbidity and decreased dissolved oxygen concentrations as a result of sediment and excrement entering the water.

- Well-intentioned **mismanagement** may be more damaging than doing nothing. For example, dredging silt and removing vegetation for the sake of creating open water may in some circumstances damage the conservation interest of ponds.

6. Strategic Actions

6.1 Recent and current activity

- The Working Towards Best Practice Project, led by **FWAG**, is carrying out a number of wetland projects on farms and promoting best practice to other farmers and landowners.
- The **Pond Monitoring Network** is establishing an online database of ponds throughout the UK.

6.2 Other recommended actions

- **Link new ponds to other habitats** within the landscape. Avoid open semi-natural habitats that are likely to already have a high biodiversity value, and important archaeological sites.
- Maintain **habitat mosaics**. Ponds associated with semi-natural habitats such as unimproved grasslands or native woods are likely to be of higher conservation value.

Extensive network of ponds within farmland at Carrick, Gatehouse of Fleet, June 2007. (Peter Norman)

PUBLIC OPEN SPACES

Priority Action (POS1)

Work with local communities to increase management and interpretation of biodiversity in public open spaces.
Target: Implement projects on 10 sites by 2011.
Lead Partner: Sulwath Connections.

Participation is the best way to learn - tree-planting day at Rhonehouse Fair Green, November 2007. (Ruth Paterson)

1. Habitat Description

1.1 Physical Characteristics

Amenity grassland is the main habitat of public open spaces, the majority of which is newly created by seeding imported topsoil and is regularly and frequently close mown. It therefore is subject to very high nutrient levels. **Sports grounds** are also uniform in character, but usually cover a much larger area than the actual playing pitch with potential for other habitats in these areas.

Town parks also usually contain large areas of amenity grassland, but these tend to have been established longer and may therefore contain remnants of previous habitats. Other influences on their value for biodiversity, apart from their management, are their size and proximity to areas of semi-natural habitat. Though there are many exceptions, the typical **park pond** is artificially created, concrete lined with vertical banks, and used for intensive activities such as boating and feeding of domestic, or semi-tame, wildfowl.

Municipal **flowerbeds** occur both within parks and in other urban areas. They tend to be intensively managed, sometimes being dug and bedding plants changed two or three times a year. However, woodchip mulch has provided a new habitat that has attracted a few specialist species, mostly fungi.

At first glance **churchyards** are merely pieces of land surrounding churches, given a different status from any garden simply because of their role as the burial grounds. But they can be significantly more species-rich than other urban environments. The main type of habitat found in churchyards is grassland, but because of their age and lower intensity management may support greater diversity than surrounding areas. In some cases this may take the form of long meadow grasses amongst which floral plants such as ox-eye daisy, common poppy and yellow rattle grow, giving the effect of a hay meadow. In other cases the grass may be much shorter allowing bird's-foot trefoil or orchids to grow. This variation in management and subsequent species diversity make carefully managed churchyards so important. **Cemeteries** are often similar in terms of wildlife and management.

Urban Trees are covered by a separate action plan, and urban ponds (other than park ponds) are included in the action plan for Urban Watercourses and Wetlands

1.2 National and International Context

Public open spaces are widespread and common throughout Britain. The rural nature of Dumfries & Galloway means that there is a lower density of such sites than in more urban environments, but there are more than 20 town parks and 130 churchyards.

2. Dumfries & Galloway Status

2.1 Recent Trends

Over the past 30 years management of public open space has become more uniform. Whilst there has been a tendency for reduced management of parks, some churchyards have become more highly managed. This has involved movement of headstones, intensification of mowing regimes, increased use of chemicals and use of machine-made black polished headstones upon which lichens cannot grow. Management of churchyards and cemeteries has therefore become more like that in amenity grasslands and parks.

2.2 Current Distribution

Public open spaces are predominantly within towns and villages and are therefore concentrated in the coastal lowlands and river valleys.

2.3 Site Examples

A number of town Parks include features of high biodiversity interest, such as the pond at **Blairmount** in Newton Stewart, grassland at **Castledykes in Kirkcudbright**, and trees at **Castledykes in Dumfries**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with public open spaces, and the following action plans may also contain relevant information: Scrub Woods, Broadleaved and Mixed Plantations, Traditional Field Boundaries, Wood Pastures and Parklands, Urban Trees, Gardens, School Grounds, Walls and Buildings, Roads and Verges, Urban Watercourses and Wetlands.

3. Importance for Associated Species

3.1 Fungi and Lichens (high importance)

Churchyards and **cemeteries** are known to support important lichen communities. Different species occur on the front, back and tops of headstones, with some 300 species recorded from British churchyards. One of the most common lichen species, the bright orange *Xanthorias* thrive on the nutrient-rich tops where bird droppings accumulate. If headstones are moved to ease management, the likelihood is that the lichens will not survive.

Leafy lichens Platismatia glauca on headstone. Durisdeer Church, March 2008. (Peter Norman)

In built-up or agriculturally improved areas, old **churchyards** and **cemeteries** that are closely mown at regular intervals can form the most important long-established grassland habitats for fungi, especially when nitrogenous fertilisers have not been applied. Some well-studied British sites have recorded more than 200 species, including important species such as Pink Meadow Waxcap *Hygrocybe calyptriformis*. However, little work has been carried out to assess such sites in Dumfries & Galloway. In **parks** and other municipal **flowerbeds**, the increasing use of woodchip mulches has encouraged the spread of several species of fungi, and even created a habitat for new species, such as *Agrocybe rivularis*.

Larch Bolete Suillus grevillei on mown grassland beneath ornamental larch. The Crichton, September 2007. (Peter Norman)

3.2 Birds (medium importance)

The mix of open grassland and trees and shrubs in many public open spaces can lead to a high density of breeding birds. Typical species include Blackbirds *Turdus merula*, Song Thrushes *Turdus philomelos*, Dunnocks *Prunella modularis* and Spotted Flycatchers *Muscicapa striata*.

3.3 Invertebrates (medium importance)

Large numbers of invertebrates are associated with public open spaces, though most tend to be species that are also common and widespread in other habitats. Typical butterflies include Small Tortoiseshells *Aglais urticae*, and where there is longer grass Meadow Browns *Maniola jurtina.* Holly Blues *Celastrina argiolus,* on the northern edge of their UK range, have been seen in the Crichton grounds. Other common invertebrates include ladybirds, hoverflies and bumblebees.

3.4 Flowering Plants (medium importance)

Over 100 species of plant may occur in an average sized **churchyard**. Typically, older churchyards have more native species, with mature Yew *Taxus baccata* and Beech *Fagus sylvatica* dominating, mixed with exotic conifers often planted in Victorian times. Shrubs including Holly *Ilex aquifolium* and climbers like Ivy *Hedera helix* are also typical.

3.5 Reptiles and Amphibians (medium importance)

Great Crested Newts *Triturus cristatus* occur in at least two ponds within towns and villages in Dumfries & Galloway at Newton Stewart and Gatehouse of Fleet. In **churchyards** and **cemeteries**, older headstones laid on their side provide basking sites for reptiles such as Common Lizards *Zootoca vivipara* and Slow Worms *Anguis fragilis*.

3.6 Mammals (medium importance)

The proximity of public open spaces to buildings, which offer bats many roosting opportunities, makes them valuable feeding areas for Pipistrelles *Pipistrellus* spp. and occasionally other species. Where dense cover is available, they may also be used by Hedgehogs *Erinaceus europaeus*.

3.7 Non-flowering Plants (low importance)

In contrast to lichens, little information has been collected on mosses and liverworts in **churchyards**, but such sites are likely to be important where the surrounding area is built-up or intensively farmed. Most species are found on headstones or other hard surfaces, such as paths. *Bryum argentum* is probably the most widespread plant in the world, growing between paving stones in virtually every town and city in the world.

Rustyback, an uncommon fern in Scotland, growing in the lime mortar of Dunscore churchyard, August 2008. (Peter Norman)

4. Environmental, Economic & Social Importance of Biodiversity

- Biodiversity enhances the interest and enjoyment of visitors.
- The different greys, greens and yellows of headstone lichens give a sense of age to the churchyard and a feeling of warmth to the stones.

5. Factors affecting the Habitat

- **Lack of knowledge** of existing value of urban habitat in the planning of developments/re-developments.
- The **threat of development** encroachment onto parks and old cemeteries.
- **Simplification of the management** of parks, cemeteries and amenity grassland. This can involve clearing of shrubs, filling-in of ponds and levelling land with hillocks and hollows making them less attractive to wildlife.
- The **use of invasive species in landscaping schemes** where this could pose a threat to existing natural habitats.

6. Strategic Actions

6.1 Recent and current activity

- **Sulwath Connections Community Biodiversity Action Project has worked with several communities to enhance public open spaces.**
- **Green Flag Awards**, judged by the Civic Trust on the quality of park and greenspace management in England and Wales, has recently been launched in Scotland.
- Judging for **Eco-congregation Awards** can include conservation management of church grounds.
- Community volunteers have created **Garries Park wildflower meadow** in Gatehouse of Fleet.
- **Lochside Park** in Castle Douglas, on the shores of Carlingwark Loch, includes wildlife interpretation and a no-boating zone to prevent disturbance to nesting birds and other wildlife.
- The **Crichton grounds** are well maintained with large areas of mown grassland and specimen trees, but minimal use of chemicals leads to an interesting range of fungi.

6.2 Other recommended actions

- Carry out an **audit of urban biodiversity information** in Dumfries & Galloway. Identify and map important areas for biodiversity within public green spaces, including parks and cemeteries.
- **Incorporate the conservation and enhancement of wildlife** into the design and management of urban greenspace.
- **Reduce negative biodiversity impacts** resulting from grounds maintenance contracts in public open spaces, parks and sports grounds (e.g. the use of herbicides, the timing and extent of grass cutting and the type of equipment used).
- **Encourage community and individual action** to survey, plan for and manage urban wildlife habitats. Consider designation as Local Nature Reserves.
- **Promote wild space in urban areas as an educational resource** to inform communities about local wildlife in the context of the wider environment.
- **Organise basic biodiversity training for staff** in order to ensure that biodiversity is considered during their everyday work.

URBAN TREES

Priority Action (UT1)

Complete a survey of all street trees in public ownership, including their location, species, approximate age and condition.
Target: Complete survey by 2015.
Lead Partner: Dumfries & Galloway Council.

Horse Chestnut and other trees are the dominant feature at Mill Green, Dumfries. September 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Urban and suburban woodland is uncommon, but small groups and single urban trees are frequent in many towns and villages. Often these consist of non-native species, typically Common Lime, Beech, Horse Chestnut, and Sycamore. A number of ornamental forms may also have been planted.

The environment experienced by urban **tree roots** is critical to their continued existence. Roots perform three important functions: stability, absorption of water and essential mineral nutrients, and storage of food. The majority of a tree's roots are in the top six centimetres of the soil. Urban trees also usually have to cope with higher levels of airborne pollutants than those in rural situations, particularly if they are located in areas of high traffic density.

1.2 National and International Context

Although there are many trees in the urban areas of Britain, it is believed that numbers are rapidly declining. For example, in London an estimated 40,000 urban trees were lost between 2001 and 2006.

2. Dumfries & Galloway Status

2.1 Recent Trends

There has continued to be a gradual loss of urban trees through development or perceptions of safety. Though there has been a considerable interest in tree planting in recent decades, many of these have not been maintained or have been smaller growing species. Few mature urban trees have been adequately replaced.

2.2 Current Distribution

The best examples of urban trees are found in long-established towns and villages. Trees in settlements of more recent origin, or recent expansion, tend be restricted to areas such as parks and churchyards.

2.3 Site Examples

Avenues of urban trees are a notable feature of the centre of some towns and villages, including **Thornhill** and **Moffat**. Trees are also a notable feature of the centre of **Kirkcudbright** and **Wigtown**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with urban trees, and the following action plans may also contain relevant information: Veteran Trees, Public Open Spaces, Golf Courses, Holiday Parks and Caravan Sites.

3. Importance for Associated Species

3.1 Invertebrates (medium importance)

Ivy growing on trees can be very important for invertebrates. Other **climbing plants** such as Honeysuckle and Traveller's Joy are of lesser value, but still provide food and habitat for many invertebrates. Horse Chestnut is prone to producing sap runs which support an interesting invertebrate fauna, whilst Common Lime has a good foliage fauna and bark-boring beetles.

3.2 Birds (medium importance)

Urban trees that are remote from semi-natural habitats generally support fewer birds than those in the countryside, but Waxwings *Bombycilla cedrorum* are remarkable exceptions. These birds, which breed in remote Siberia, occasionally winter in Britain in large numbers and in Dumfries & Galloway have been recorded on trees in car parks at the Council Offices and Morrisons supermarket in Dumfries, and the M74 services at Gretna. They favour bearing-bearing trees. More typical species include Starlings *Sturnus vulgaris*, House Sparrows *Passer domesticus* and Greenfinches *Carduelis chloris*.

3.3 Mammals (medium importance)

Bats find many roosting opportunities in urban areas, and in some locations street trees provide the only opportunity to find insect food they need to survive.

3.4 Fungi and Lichens (low importance)

In Dumfries & Galloway's towns, air quality is much better than in other urban areas, but still may be sufficient to prevent colonisation by the most sensitive lichen species.

4. Environmental, Economic & Social Importance of Biodiversity

- Urban trees contribute to the landscape character, setting and local distinctiveness of towns and villages.
- Trees improve people's quality of life and reduce everyday stress through their aesthetic qualities, by providing shade and humidity, by reducing noise levels and by providing privacy.
- Trees provide summer shade and winter shelter enabling the saving of energy.
- Trees affect air quality, both negatively by emitting gases known as volatile organic compounds (VOCs) that contribute to the production of pollutants, and positively by removing pollutants, especially ozone, nitrogen dioxide, and particles from the air. Different tree species in different locations perform differently, but generally Ash, Alder, Larch, Silver Birch, Scot's Pine are best, oaks and willows are worst, in terms of improving air quality.
- Particles in the air have an impact on human health. Mature, mixed woodland captures airborne particles at approximately three times the rate of grassland. A study in the West Midlands predicted that doubling the number of trees could reduce excess deaths due to particles in the air by up to 140 per year.
- Trees also remove carbon dioxide from the atmosphere, but in Dumfries & Galloway this is a very minor contribution to carbon sequestration.

Urban trees include some unusual species, such as this Indian Bean Tree at St.Michael's Church, Dumfries. (Peter Norman)

- Trees positively affect property values.
- Several urban trees are local landmarks and have been the subject of local artists.

5. Factors affecting the Habitat

- Newly planted trees may struggle to grow and survive in towns due **poor growing conditions** as a result of compacted soils and a shortage of mineral nutrients.
- **Above average air temperatures** created by heat radiating off tarmac, paving, glass and buildings can cause already drought-stressed trees to lose even more water.
- **Neglect**, including lack of water, weed infestation, constricting ties on standard trees (which restrict the flow of water and sap), strimmer and mower damage (which damages and removes the bark), overdosing/misuse of herbicide and de-icing salt (which then becomes toxic to trees).
- **Vehicles** that accidentally drive into trees damage bark, break stems and snap roots. Guards, fencing and posts can help trees to avoid vehicle damage.
- **Service runs** including drains, sewers, water, electricity, gas, telephone and cable TV laid via open trenching can cause serious disruption to existing trees by damaging or severing roots, making the tree unstable and reducing its capacity to absorb water, oxygen and essential mineral nutrients. Leaks from some of these

services, such as gas and water, can harm or kill roots.

- **Engineering work**, including installation and maintenance of paving slabs and tarmac, kerbs and private driveways may cause severance or damage to roots.

Pollarded Lime trees are a feature of the centre of Thornhill. May2008. (Peter Norman)

- Trees growing in certain locations may be a source of **conflict with the public**. Complaints usually involve blocking of light, fear that they may fall and damage people or property, or seasonal problems such as leaf fall. These may result in pruning or removal of these trees.
- Pressure to fit as many houses as possible on development sites can bring trees into direct **conflict with building projects**. As sites become crowded during construction, and trees are subsequently damaged by machinery, fires and storage of materials. In the long-term such trees may become unstable and/or diseased and may be felled.
- Even where trees are successfully retained on a site, often **consideration is not given to their long-term growth requirements**, in terms of height and width. As a result, residents of the site may become concerned as these trees begin to reach above the roof tops, block increasing levels of light and drop more leaves.
- Long-term management of urban trees **can be expensive** if carried out to the correct professional standard, and therefore may be neglected. As a result drastic action is often taken such as lopping/topping, heavy crown reduction or removal, as this provides an immediate quick fix solution, even though these options are not good for the tree and the safety of people.
- **Vandalism** of trees can take two main forms: Opportunistic snapping of side branches, breaking off crowns, uprooting and pulling whole trees out of the ground, and premeditated ring barking, sawing off branches/crowns of young trees and poisoning roots. It is illegal to damage a public/protected tree, but this often fails to perturb the vandal. Tree vandalism is a social problem, not a tree problem.
- **Deliberate removal of Ivy** from trees destroys a valuable wildlife habitat. However, dense ivy can restrict tree safety surveys and increase the tree's susceptibility to windthrow. Each case should be considered individually, but it may be best to prevent a dense covering being created.
- Future **colonisation of Grey Squirrels** in urban areas, parks and cemeteries may cause damage through bark stripping.

6. Strategic Actions

6.1 Recent and current activity

- Tree Preservation Orders, Conservation Area Orders and Planning Conditions serve to ensure that trees are retained and protected during and after construction works.
- British Standard 5837 'Trees in relation to Construction' provides guidance, in respect of development sites. It applies to applications for most developments where construction work is involved, but will not generally be applied to householder applications unless the site contains a large number of trees.

6.2 Other recommended actions

- Strengthen protection for urban trees, including the use of **Tree Preservation Orders** in areas where they will safeguard biodiversity.
- Ensure the successful **retention of trees in development works**.
- Encourage owners and occupiers of land to **safeguard and re-instate hedgerows and trees of biodiversity value** where these are affected by development or re-development proposals.
- **Report contractors** who are suspected of carrying out unauthorised works to protected trees.
- **Education and raising awareness** of trees is the best way to reduce vandalism.

TRADITIONAL ORCHARDS

Priority Action (TO1)

Compile a database of traditional orchards, including any known historical and biodiversity information, to determine their extent, distribution, composition and status in Dumfries & Galloway.
Lead Partner: Dumfries & Galloway Orchard Network.

1. Habitat Description

1.1 Physical Characteristics

Orchards are collections of cultivated fruit trees such as apples, pears and plums and/or damsons although nut-bearing trees such as Walnuts and Hazelnuts can also be present. Traditional orchards are those which have been planted and managed less intensively than modern commercial orchards and therefore have high ecological value. The combination of old individual trees within grassland gives a habitat with similarities to wood pasture or parkland. Trees within old orchards can be over 60 years old and as fruit trees decay more quickly than most British hardwoods they can provide crevices and hollows for nesting birds.

Traditional orchards are also important reservoirs of genetic diversity in supporting locally distinctive varieties of fruit such as the Galloway Pippin that are increasingly rare.

1.2 National and International Context

There are no readily available statistics for orchard numbers, areas and production within Scotland but it is clear that the Clyde Valley has always been the most significant orchard area. Other areas with a tradition of significant orchard cultivation include Dumfries & Galloway, the Borders and the area around Carse of Gowrie on the Firth of Tay. Elsewhere in the UK there are many orchard areas, where as well as growing commercial eating fruit, significant acreage is given over to cider apple production, not a tradition in Scotland. Most of these orchards are in the south of England. Figures suggest that in 1997 there were 22,400ha of commercial orchards in the UK, a 64% decline in 27 years.

2. Dumfries & Galloway Status

2.1 Recent Trends

During the 20th Century apple growers were encouraged to use a range of apple that was more productive and this led to a decline in varieties traditionally grown in Dumfries & Galloway. Today there are very few orchards left in Dumfries & Galloway, with occasional remnants remaining in gardens of country estates or large houses, farm houses and Victorian back gardens.

2.2 Current Distribution

Dumfries & Galloway is not an area renowned for large-scale commercial apple growing due to the unreliable weather conditions. However, the UK BAP distribution map suggests that there are six 10x10km grid squares in Dumfries & Galloway which have traditional orchards within them. Further survey work is required to assess these sites and to establish current distribution.

2.3 Site Examples

Some country estates and houses have remnants of old orchards such as **Galloway House Gardens** and **"Croft-an-Righ" House** in Wigtown, another possible location of the original Galloway Pippin known locally as the Croft-angry apple.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with traditional orchards, and the following action plans may also contain relevant information: Neutral Grasslands, Native Woods, Wood Pastures and Parklands.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Species rich unimproved grassland is often associated with traditional orchards, especially where applications of fertilisers have been kept to a minimum. Species likely to be found in these grass swards include Yellow Rattle *Rhinanthus minor,* Meadow Cranesbill *Geranium pratense*, Devil's-bit Scabious *Succisa pratensis* and various orchid species.

Peacock butterfly. (Paul McLaughlin)

3.2 Invertebrates (high importance)

The blossom of fruit trees can also provide a source of nectar for invertebrates such as bees, butterflies and hoverflies, whilst the dead wood of mature trees orchards can form important refuges for dead wood (saproxylic) invertebrates.

3.3 Birds (medium importance)

Bullfinch. (Paul McLaughlin)

Flower buds and leaf buds provide food for birds such as Bullfinches *Pyrrhula pyrrhula*, whilst windfall fruit is eaten in autumn and winter by Fieldfares *Turdus pilaris,* Redwings *Turdus iliacus* and other thrushes. Birds such as Woodcocks *Scolopax rusticola*, Green Woodpeckers *Picus viridis* and Spotted Flycatchers *Muscicapa striata* that are associated with wood pastures are also attracted to orchards, along with Buzzards *Buteo buteo*, Barn Owls *Tyto alba* and Tawny Owls *Strix aluco* that may roost in mature trees and forage over open grassy areas.

3.4 Fungi and Lichens (medium importance)

A diverse fungus flora is associated with old or dead trees. Several species of waxcap, including the Pink Waxcap *Hygrocybe calyptraeformis* are among many small fungi characteristic of such pastures. *Sarcodontia crocea* is a rare fungus that seems to specialise in old apple trees, though has not yet been recorded in Dumfries & Galloway.
The bark of fruit trees can support a good cover and range of lichens such as *Parmelia sp.*

3.5 Mammals (medium importance)

Various species of bats use orchards. Pipistrelles *Pipistrellus spp.* and Brown Long-eared Bats *Plecotus auritis* find the open scrub habitat provided by some orchards suitable as foraging habitat, and if the trees are old enough to produce crevices, then species such as Pipistrelle and Noctule *Nyctalus noctula* may also use them as roosting sites. Other mammals such as Red Squirrels *Sciurus vulgaris*, Badgers *Meles meles* and deer are attracted to this habitat type, and a range of small mammals such as mice and voles is also found.

3.6 Non-flowering Plants (medium importance)

Many mosses and liverworts grow on fruit trees, and species associated with damp unimproved grasslands are found in orchards in the region.

3.7 Reptiles and Amphibians (low importance)

If ponds are present within orchards then it is likely that amphibians will be present.

4. Environmental, Economic & Social Importance of Biodiversity

- Traditional varieties of fruit, produced with high environmental standards, can be marketed to a specific, high spending market.
- Traditional orchards can be grazed by sheep or cattle.
- Many invertebrates act as biological control agents against pests of fruit. For example the mirid bugs *Blepharidopterus angulatus* and *Psallus ambiguu* are predators of Fruit-tree Red Spider Mite, the flower bugs *Anthocoris nemorum* and *Anthocoris nemoralis* feed on aphids, and the Common Earwig *Forficula auricularia* is an important predator of Codling Moths. The Whirligig Mite *Anystis baccarum* impacts on Apple-grass aphid populations and has also proved compatible with various fungicides commonly used for apple scab control. It therefore offers much potential to be integrated into pest control programmes for apple orchards.
- Sites can be used for educational activities, guided walks and talks.

5. Factors affecting the Habitat

- **Lack of information and understanding** about the distribution, quality and importance of this habitat leading to poor appreciation of its value.
- Loss of habitat due to **grubbing out or death of mature trees**.
- **Agricultural improvement** through drainage, cultivation and fertiliser applications.
- **Agricultural abandonment**, leading to rankness and scrub encroachment through lack of management.
- **Inappropriate management**, including overgrazing by horses.
- Most beneficial invertebrates are susceptible to **agrochemicals** and cannot survive in intensively managed orchards.
- **Development** of land adjacent to village or estate orchards.

6. Strategic Actions

6.1 Recent and current activity

- The **Dumfries & Galloway Orchard Network** was set up in 2000 to promote the understanding and enhancement of traditional apple varieties in the region.

6.2 Other recommended actions

- **Encourage the enhancement and reinstatement of orchards** on traditional orchard sites.
- **Promote greater awareness** of the importance of this habitat and its sensitivity to land use changes.
- **Arrange activities** such as Apple Days and Budding Days through the Dumfries & Galloway Orchard Network.

GARDENS

Priority Action (GA1)

Encourage public gardens and garden centres to promote wildlife gardening by installing garden wildlife interpretation.
Target: Interpretation at 3 sites by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Priority Action (GA2)

Promote a garden that demonstrates good practice for wildlife management.
Target: Establish demonstration garden by 2012.
Lead Partner: Solway Heritage.

1. Habitat Description

1.1 Physical Characteristics

Private gardens are small in size, subject to high levels of disturbance, and being most common in urban areas, tend to be subject to higher levels of air pollution than the countryside. Individual gardens therefore have limited biodiversity potential. However, their value is considerably enhanced by the fact they are highly clustered, resulting in habitat mosaics that cover a significant area and are considerably more diverse than much of the surrounding countryside. **Public gardens** are similar in many respects, but tend to be much larger and contain larger patches of different habitats.

Vegetable plots are sometimes a feature of private gardens, but vegetables are more commonly grown on **allotments**. These are larger than private gardens and tend to have less intensive management. **Market gardens** commercially grow fruit vegetables and flowers in greenhouses or polytunnels.

Garden **lawns** are usually planted with just one or two species of grass, but other plants quickly colonise all but the most intensively managed lawns. All are adapted to frequent and short cutting with a lawnmower. **Flower beds** are usually stocked with non-native flowers and subject to regular digging, weeding, and sometimes regular replacement of plants. The use of wood chip mulches to reduce the need for weeding has provided a garden habitat that has attracted some species associated with dead wood. **Shrubs and trees** mimic more natural woodland habitats, at least in terms of their structure. **Compost heaps** are also a feature of some gardens, and a few have installed **log piles**, specifically for biodiversity reasons.

Garden Ponds are typically very small and shallow, and are often subject to rapidly fluctuating water levels and temperatures, and high inputs of nutrients from adjacent grass cutting and chemical use. However, as with gardens generally, aquatic biodiversity benefits from the close proximity of ponds to each other, allowing rapid recolonisation of many species.

1.2 National and International Context

There are some 16 million UK gardens covering more than 1.2 million hectares (3 million acres). In Dumfries & Galloway there are approximately 60,000 households, the majority of which have gardens, resulting in an estimated area of almost 5,000ha (12,000 acres). This is larger than the combined total of all wildlife reserves in the region managed by RSPB, SWT and WWT.

2. Dumfries & Galloway Status

2.1 Recent Trends

Although the average size of private gardens has probably not increased in recent years, there has been a continued increase in number. There has also been an increasing tendency for hard surfacing, with more paving, tarmac and gravel, and an increase in the use of garden chemicals. However, wildlife gardening has also become much more popular, especially a dramatic increase in the number of bird feeders and nest boxes.

2.2 Current Distribution

The majority of Dumfries and Galloway's **private gardens** and **allotments** are located in the main urban areas of Dumfries and Stranraer, with smaller numbers in other towns and villages. In contrast, **public gardens** generally have a more rural location. **Market gardening** is not an important activity in Dumfries & Galloway. Nevertheless, in 2006 there were 12,755 square metres of glasshouses/ polytunnels on 22 sites, mostly growing bedding plants and pot plants.

2.3 Site Examples

Glenwhan Gardens at Dunragit has created and promoted wildlife habitats, and biodiversity has been promoted by special wildlife events at **Blackstone Garden Plants** in Kippford.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with gardens, and the following action plans may also contain relevant information: Walls and Buildings, Public Open Spaces, Urban Trees, Traditional Orchards.

3. Importance for Associated Species

3.1 Reptiles and Amphibians (high importance)

Garden ponds are extremely valuable for amphibians. Even the smallest pond can support breeding Common Frogs *Rana temporaria,* Smooth Newts *Lissotriton vulgaris* and Palmate Newts *Lissotriton helvetica.* Common Toads *Bufo bufo* prefer larger ponds. **Log piles** provide essential hibernation sites.

Garden ponds provide a valuable habitat for Common Frogs. Kirkconnel, June 2007. (Greg Baillie).

Slow Worms *Anguis fragilis* occur in suitable gardens in greater density than in many semi-natural habitats, although populations may be seriously affected by cat predation. **Compost heaps** are a favoured egg-laying site for Grass Snakes in southern England, though the presence of this species in Dumfries & Galloway is not confirmed.

3.2 Invertebrates (high importance)

More than 11,000 species of invertebrate has been recorded from a single British garden. The average for a garden in Dumfries and Galloway will be considerably lower, but will nevertheless be counted in the thousands.

Flower beds, even those composed entirely of non-native species, can be rich in nectar sources for bees, butterflies, moths and hoverflies and can provide such nectar (and pollen) early and late in the season when natural sources are not abundant.

Wool Carder Bees *Anthidium manicatum* are striking medium-sized bees that are common in southern England. However the only Scottish records come from Dumfries & Galloway where they can be found hovering around patches of labiates, including those in garden flower beds. Other garden bees include Red Mason Bees *Osmia rufa*, Rose Leaf-cutter Bee *Megachile centuncularis,* Honey Bees *Apis mellifera* and the bumble bees *Bombus pratorum, B. pascurum,* and *B.terrestris.* The first Scottish record of a mining bee *Lasioglossum morio* came from Threave Gardens in 2006, although this species is not generally a garden specialist.

Garden butterflies are mainly common widespread species such as whites, Small Tortoiseshells *Aglais urticae* and Peacocks *Inachis io*, but the first recorded breeding of Holly Blue *Celastrina argiolus* in Scotland came from a Rockcliffe garden in 2004.

The average suburban garden in Dumfries & Galloway is likely to support in excess of 200 species of moth. One species, Blair's Shoulder-knot *Lihophane leautieri*, is virtually confined to gardens, as its caterpillars feed on planted **shrubs and trees** of the cypress family. First recorded in Britain in 1951, it reached Kirkcudbright in 2001 and is now found in gardens across the region. Conversely, the decline of Currant Clearwing Moth *Synanthedon tipuliformis* may be linked to fewer currant plants being grown in **vegetable plots** and **allotments**.

Most **garden ponds** will support common species of breeding damselflies, as well as pond skaters, water beetles, pond snails and other aquatic invertebrates.

3.3 Birds (medium importance)

Much time and money is spent erecting nest boxes and feeders for garden birds, but of much greater importance is the structure of garden vegetation. **Shrubs and trees** provide food, nest sites and protective cover from predators such as cats for Dunnocks *Prunella modularis* and Robins *Erithacus*

House Sparrows, in rapid national decline, are still common in local gardens. (Gordon McCall)

rubecula; **lawns** offer feeding opportunities for Blackbirds *Turdus merula* and Song Thrushes *Turdus philomelos*; **garden ponds** provide essential drinking and bathing opportunities for many species.

Blackbirds nest in high densities in gardens. (Paul McLaughlin)

Spotted Flycatchers *Muscicapa striata* are declining across the UK, but populations in gardens seem to be fairing better than those in woodland or farmland. There has also been a dramatic reduction in numbers of House Sparrows *Passer domesticus* in Britain, though local declines have not been detected. Reasons for the national trend are unclear, but increased use of garden chemicals and the corresponding reduction in weed seeds has been implicated as a contributory factor.

Agrocybe rivulosa on garden woodchips. Nunholm, Dumfries, August 2007. (Peter Norman)

3.4 Fungi and Lichens (medium importance)

Few species of fungus are specifically associated with gardens. Perhaps the Fairy Ring Champignon *Marasimus oreades*, though not restricted to garden **lawns**, is one species best known from this habitat. Old lawns that are regularly mown but have not received fertilisers or herbicides are now rare, but where they occur they can provide a nationally important habitat for uncommon species of fungi, especially waxcaps *Hygrocybe* spp. Lawns with moss are particularly valuable.

The practice of using wood chips for mulching **flower beds** and on garden paths has introduced a new fungal habitat to Britain in recent years. *Agrocybe rivularis*, new to science in the Pennines in 2003, was discovered on a pile of wood chips at Nunholm, Dumfries in 2007. Other species have been introduced with exotic plants. The False Truffle *Hydnangium carneum,* known in Britain since 1875, has been found in association with eucalypts at Logan Botanic Garden.

Common species of lichen may be found on **shrubs and trees**, as well as garden paths, walls and fences.

3.5 Mammals (medium importance)

Hedgehogs *Erinaceus europaeus* occur in a greatest density where grassland and woodland is found in close proximity. A mosaic of garden shrubs and trees, together with lawns therefore provides an ideal habitat. They can occur here at a density of more than 1 per 5-10ha, compared with 1 per 15-20ha in plantations and farmland.

Common and Soprano Pipistrelle bats *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus* regularly roost in houses and feed over gardens.

3.6 Non-flowering Plants (low importance)

A typical suburban garden may support more than 20 species of bryophyte, though most are common species. Common Liverwort *Marchantia polymorpha* is a frequent garden species, often sharing plant pots with garden flowers, whilst Crescent-cup Liverwort *Lunularia cruciata* may be found on paving and patios. Few species occur in flower beds, but Springy Turf-moss *Rhytidiadelphus squarrosus*, a ubiquitous species usually at home in grassland, is found on **lawns** where the grass is kept short through mowing. Here it can form extensive, almost pure swards of moss. Several species of bryophyte have been introduced with imported plants, though none have yet had a significant impact on wild populations.

3.7 Flowering Plants (low importance)

Many wildlife garden publications recommend planting predominantly native flowers to benefit garden wildlife. However, such plants can never replace or support wild populations, and recent research has even suggested that native species do not necessarily offer greater benefits to insects and birds than exotic plants. A mix of native and introduced flowers may be most beneficial, especially

if these are nectar-rich plants. A high variety of plant structures from low-growing creepers to tall shrubs and trees, supports the greatest diversity of wildlife.

3.8 Fishes (low importance)

As well as ornamental fish, **garden ponds** may support some species of native fish, such as sticklebacks. However, garden populations make an insignificant contribution to fish conservation and for the benefit of amphibians and insects all fish are best kept out of garden ponds wherever possible.

4. Environmental, Economic & Social Importance of Biodiversity

- Wildlife adds to the interest and enjoyment of gardens.
- Insects are responsible for the pollination of many garden plants. Bumblebees are particularly important for fruit trees and soft fruits.
- Other insects are important predators or parasites of garden pests. Less than 1% of insects are garden pests.

5. Factors affecting the Habitat

- **Intensive lawn management** involving moss removal, fertiliser and herbicide application reduces biodiversity value. Various species of microfungi are associated with grasses and in natural grasslands they present no special problems, but in the artificial monocultures of ornamental lawns they can attack and damage seedlings of fine grasses and established turf. Nevertheless, care should be taken in the application of fungicides, since many other microfungi play a vital role in recycling nutrients and form mutually beneficial associations with grasses.
- Garden plants have sometimes been **sourced from the wild**, either in Britain or abroad, weakening native populations.
- The introduction of **non-native varieties of British native wildflowers** has the potential to threaten on wild populations.
- The use of **peat** in gardens damages rare and important semi-natural peatlands that support species not found in other habitats.
- The use of **limestone** in gardens damages rare and important semi-natural limestone pavements that support species not found in other habitats.
- **Predation by domestic cats** can cause local reductions of some birds and mammals.
- **Poor hygiene and overfeeding of garden birds** can result in potentially lethal bird diseases building up in uneaten food and unwanted garden pests, such as rats.

6. Strategic Actions

6.1 Recent and current activity

- Advice on wildlife gardening has been published by many organisations including the **Royal Horticultural Society.**
- **Garden Wise** garden centre in Dumfries has promoted biodiversity during special weekends.

6.2 Other recommended actions

- Encourage garden owners to **contribute to national garden wildlife surveys** such as RSPB's Big Garden Birdwatch, BTO's Garden Bird Survey and Butterfly Conservation's Garden Butterfly Survey.
- Promote garden biodiversity through **garden open days, walks, talks and lea**flets.

White-tailed Bumblebee Bombus lucorum. Dalry garden, April 2007. (Maggi Kaye)

SCHOOL GROUNDS

Priority Action (SG1)

Encourage schools to establish and maintain school wildlife areas and use these areas as part of the curriculum-based teaching programme.
Target: Organise in-service training day for teachers by 2012.
Lead Partner: Eco Schools/Dumfries & Galloway Biodiversity Partnership.

Pupils at Port William Primary admire a new pond. (EcoSchools)

1. Habitat Description

1.1 Physical Characteristics

School grounds vary widely in size, but this has little bearing on their biodiversity or environmental educational value. Of much greater importance is the variety of habitats and features within the grounds, together with their soil type and proximity to natural habitats. The type of school also has an influence. Research has shown that primary schools are the most likely to have a school wildlife area, but that greatest demand for such areas is from nursery schools. Secondary schools are least likely to develop part of their grounds for wildlife, but around 5% of all Scottish schools also maintain grounds in the wider community.

Most schools have existing features that can be enhanced for wildlife, but there are also opportunities to create new ones from scratch. Hard surface areas such as **playgrounds** dominate the school landscape, and these have only limited opportunities for enhancement. **Playing fields** offer more biodiversity benefits, but opportunities for enhancement are also limited without affecting their primary purpose. However there are usually significant areas around the edges of playing fields that are underused. Most tend to be unnecessarily flat, which restricts their aesthetic and wildlife value, but most have **trees and shrubs** - the most commonly occurring wildlife habitat in Scottish school grounds.

2. Dumfries & Galloway Status

2.1 Recent Trends

In recent decades there has been more recognition of the importance of school grounds to the educational development of children. Many have planted trees and created gardens and wildlife areas. New schools often have such features built into their design.

2.2 Current Distribution

School grounds are located in all the main towns in the region.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with school grounds, and the following action plans may also contain relevant information: Public Open Spaces, Gardens, Walls and Buildings, Urban Trees.

3. Importance for Associated Species

3.1 Reptiles and Amphibians (high importance)

Common Frogs *Rana temporaria* and possibly newts breed in quite small ponds in school grounds, so long as there is sufficient adjacent long grass for feeding.

3.2 Invertebrates (high importance)

Many attractive invertebrates that are likely to appeal to children can be attracted to school grounds through planting of nectar-rich species. Foremost almost these are the butterflies, such as Small Tortoiseshells *Aglais urticae*, Painted Ladys *Vanessa cardui* and Red Admirals *V. atalanta.* Others include ladybirds, bumblebees and dragonflies on ponds.

3.3 Birds (medium importance)

Blackbirds find food on school playing fields. Minnigaff, April 2008. (Gavin Chambers)

Traditional features of school grounds attract several species of birds: **Playgrounds** are visited by House Sparrows *Passer domesticus* and Pied Wagtails *Motacilla alba*; **playing fields** attract Blackbirds *Turdus merula* and Rooks *Corvus frugilegus*. **Trees and shrubs**, particularly if close to woods, attract Chaffinches *Fringilla coelebs*, Greenfinches *Carduelis chloris* and tits. Most stay well hidden, but can easily be attracted to feed in front of classroom windows by bird tables and feeders. Oystercatchers *Haematopus ostralegus* have nested on the roof of Dalbeattie School.

Robins are shy woodland birds in much of Europe, but in Britain can become quite tame with regular feeding. (Gordon McCall)

3.4 Mammals (medium importance)

A range of mammals is present in most school grounds, but most tend to be nocturnal. Hedgehogs *Erinaceus europaeus* and bats benefit from areas of longer grass that support more insects.

3.5 Flowering Plants (low importance)

School grounds are unlikely to support any important species of wildflower, but common species such as thistles, and garden flowers, are important food sources for insects and birds.

4. Environmental, Economic & Social Importance of Biodiversity

- School grounds have the potential to contribute to schemes that promote wider environmental stewardship, such as through Eco Schools and Forest Schools. The way school grounds are developed and used can have a significant impact on pupils' attitudes and behaviour, towards school, towards each other and towards the wider environment and society.
- Much of the formal curriculum can be taught outside. Indeed some can only be taught outside.

5. Factors affecting the Habitat

- Pupils spend as much as 25% of their time at school in school grounds, but wildlife usually adapts to such disturbance and **noise and activity** is rarely a problem.
- **Long-term maintenance** requires commitment from enthusiastic staff, as well as assistance from grounds staff.
- Most school grounds have **subsoil that has been compacted** by heavy machinery, a drainage system intended for playing fields, and rich topsoil dominated by a few very vigorous grasses. This hinders good root development by trees and shrubs and the encouragement of wildflowers.

6. Strategic Actions

6.1 Recent and current activity

- All 125 state schools in Dumfries & Galloway are registered for the **Eco Schools** programme and more than 100 of them have won the Bronze Eco School Award or higher. Most have done work on their school grounds as part of this award.

6.2 Other recommended actions

- Encourage **promotion of biodiversity in environmental education** by Ranger visits to schools, visits by schools to biodiversity sites, and support for the establishment of school nature clubs.

GOLF COURSES

Priority Action (GC1)

Prepare or update environmental statements for golf courses in Dumfries & Galloway.
Target: 5 courses by 2012.
Lead Partner: Scottish Golf Environment Group.

Priority Action (GC2)

Improve biodiversity knowledge and training for golf course staff by holding a golf and biodiversity training day.
Target: Hold training day by 2012.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Habitat Description

1.1 Physical Characteristics

The range of wildlife found on golf courses depends upon the locality of the course, its soils, topography, and range of habitats. All have extensive areas of mown grass, but golf courses have a range of other features such as bunkers and '**rough**', as well as substantial 'out-of-play' areas such as **water hazards**, **trees and small woods**. Coastal courses can have additional features, sometimes including dunes and coastal grasslands. All can be enhanced by relatively small changes that cost little or nothing and may enhance playing conditions.

Bloody Cranesbill in the rough at Glenluce Golf Course, 1999. (Peter Norman)

1.2 National and international context

There are some 27,000 hectares of golf course in Scotland. The area in Dumfries & Galloway is not accurately known, but there are 31 courses/driving ranges in the region.

2. Dumfries & Galloway Status

2.1 Recent Trends

A number of new courses and driving ranges have become established in Dumfries and Galloway in recent years, and others have expanded. This increase has taken place predominantly on farmland.

2.2 Current Distribution

Most golf courses are located close to the major towns and villages. Almost a third of all courses include elements of coastal habitats.

2.3 Site Examples

Several local golf courses have carried out biodiversity enhancement work, including **Brighouse Bay Holiday Park Golf Course** and **Southerness Golf Course** (SSSI/LWS).

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with golf courses, and the following action plans may also contain relevant information: Coastal Sand Dunes, Broadleaved and Mixed Plantations, Wood Pastures and Parklands, Farm Ponds, Public Open Spaces, Urban Trees.

3. Importance for Associated Species

3.1 Flowering Plants (medium importance)

Though closely mown fairways are of little importance for wildflowers, there may be more botanical diversity in areas of light **rough** than in unmanaged grasslands. In such cases, occasional cutting reduces competition from coarse grasses, allowing species such as Pignut *Conopodium majus* and Cuckoo Flower *Cardamine pratensis* to grow. Unimproved grasslands are rare, though excellent examples are found at Glenluce. Creation of **water hazards** can provide conditions for aquatic plants to colonise, such as the locally scarce Lesser Bulrush *Typha angusifolia* at Brighouse.

3.2 Mammals (medium importance)

Mature **trees and small woods** provide excellent roost sites for bats. Younger trees currently dominate most local courses, but even here the mosaic of trees,

rough and **water hazards** provides many feeding opportunities for bats. Daubenton's Bats *Myotis daubentonii* make nightly feeding forays over ponds at Cally during the summer.

3.3 Birds (medium importance)

The intricate mix of open grassland, trees and small woods on golf courses can lead to a higher density of breeding birds that are more usually found on woodland edges. Typical species include Song Thrushes *Turdus philomelos*, Dunnocks *Prunella modularis* and Spotted Flycatchers *Muscicapa striata*. More open courses, often those on the coast, may have Skylarks *Alauda arvensis* nesting in the rough.

3.4 Reptiles and Amphibians (medium importance)

Water hazards provide breeding opportunities for Common Toads *Bufo bufo,* Common Frogs *Rana temporaria* and Palmate Newts *Lissotriton Helvetica*, the adults of which feed in areas of **rough**.

3.5 Invertebrates (medium importance)

Regular cutting of fairways and rough prevents flowering, whilst unmanaged rough is dominated by grasses. Therefore opportunities for nectar-feeding invertebrates are often few, unless there are areas of nectar-rich grassland. Likewise, bunkers are too heavily managed for most sand-nesting solitary bees. **Trees and small woods**, especially mature trees, provide the best invertebrate habitats, though common aquatic species are also found in **water hazards.**

Ponds can attract a range of dragonflies, such as Emerald Damselflies. (Richard Mearns)

3.6 Fungi and Lichens (low importance)

Trees and small woods on golf courses potentially provide a good fungus and lichen habitat, with light and humidity conditions not dissimilar to those in wood pastures. However, this is presently limited by the relatively young age of most such features on golf courses in Dumfries & Galloway. Short grassland, away from intensively managed areas, may also be good for waxcap fungi, but the presence of such areas in the region is currently not known.

4. Environmental, Economic & Social Importance of Biodiversity

- Integration of sound environmental principles should ensure that golf clubs reduce over-management and minimise maintenance costs.
- Biodiversity enhances the aesthetic character, atmosphere and challenge of the course.

Small Copper butterfly in the rough at New Galloway Golf Course, August 2008. (Peter Norman)

5. Factors affecting the Habitat

- The **loss of semi-natural habitats during course creation** has not been a major issue in Dumfries & Galloway where recent courses have been created on improved farmland.
- **High levels of fertilisers and chemicals** may runoff or seep into watercourses, causing nutrient over-enrichment and pollution.
- **Intensive grassland management** around the roots of mature trees damages root systems leading to poor tree health and premature death.

6. Strategic Actions

6.1 Recent and current activity

- The **Scottish Golf Environment Group** has assisted several courses in Dumfries & Galloway to prepare holistic environmental management plans, so that all relevant environmental issues are recognised for different parts of the golf facility.
- A biodiversity survey of selected courses was carried out by a student from **Scottish Agricultural College** Auchincruive in 2002/3.
- **Brighouse Bay** was the overall winner of the Scottish Award for Environmental Excellence on Golf Courses in 2006.

6.2 Other recommended actions

- **Develop partnerships** with local clubs to carry out projects to enhance biodiversity.

HOLIDAY PARKS & CARAVAN SITES

Priority Action (HPCS1)

Raise awareness of biodiversity for visitors to holiday parks and caravan sites by organising wildlife interpretation and/or events.
Target: 10 events by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

Guided walk looking at shells on the beach at Sandyhills Holiday Park. (2007)

1. Habitat Description

1.1 Physical Characteristics

Holiday parks and caravan sites consist of wooden chalets, caravans and sometimes a camping area, located on an extensive area of mown grassland. A few sites are located within open mature woodlands, but even those that are not usually have areas of planted trees and shrubs. Additional features found on some sites include play areas, sports facilities, more formal garden areas, ponds and sometimes areas that are managed specifically for wildlife.

A key feature that influences the biodiversity of holiday parks and caravan sites is their proximity to semi-natural habitats such as coasts and woods. However, management should be used to increase the value of all sites.

2. Dumfries & Galloway Status

2.1 Recent Trends

Over the last 10 years, holiday parks and caravan sites have continued to increase in size and the range of facilities offered. There has also been an increase in the number and size of semi-permanent wooden chalets.

2.2 Current Distribution

Holiday parks and caravan sites are widespread across Dumfries and Galloway, but tend to be concentrated on the coast.

2.3 Site Examples

Several holiday parks and caravan sites have already carried out enhancements for wildlife and promoted wildlife attractions for their visitors. These include **Brighouse Bay Holiday Park, Kippford Holiday Park** and **Barnsoul Farm** at Shawhead.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with holiday parks and caravan sites, and the following action plans may also contain relevant information: Walls and Buildings, Public Open Spaces.

3. Importance for Associated Species

3.1 Birds (medium importance)

Bullfinch, a colourful species that can be attracted to nest in dense trees and bushes. (Gordon McCall)

The mosaic of grassland and trees and shrubs attracts a high density of common birds more typical of woodland edges. These include Blackbirds *Turdus merula,* Song Thrushes *Turdus philomelos,* Robins *Erithacus rubecula* and Starlings *Sturnus vulgaris*. Dunnocks *Prunella modularis* and Willow Warblers *Phylloscopus trochilus* use scrub, whilst Spotted Flycatchers *Muscicapa striata* benefit from scattered trees.

3.2 Invertebrates (medium importance)

Though most invertebrates likely to be found on holidays parks and caravan sites are common and

widespread species, these can include some very attractive species that are likely to appeal to visitors. Foremost amongst these are the butterflies, and it should be possible to attract Small Tortoiseshells *Aglais urticae*, Painted Ladys *Vanessa cardui* and Red Admirals *V. atalanta* to most sites. Others include ladybirds, bumblebees and dragonflies on ponds.

3.3 Reptiles and Amphibians (medium importance)

Common Toads *Bufo bufo,* Common Frogs *Rana temporaria* and Palmate Newts *Lissotriton Helvetica* have all been recorded breeding in ponds within holiday parks. Great Crested Newts *Triturus cristatus* may also occur. All require suitable terrestrial habitats, such as long grass, as well as breeding ponds.

A mix of woodland and grassland provides good habitat for Hedgehogs. Loch Ken, June 2006. (Peter Norman)

3.4 Mammals (low importance)

Caravans are rarely suitable roost sites for bats. However, if alternative roosting locations are available nearby, the mix of trees, shrubs and open areas makes holiday parks valuable feeding areas for bats. For example, one of the few known Noctule *Nyctalus noctula* roosts in the region is at Loch Ken Holiday Park. Dense cover is also attractive to other mammals, such as Hedgehogs *Erinaceus europaeus*.

3.5 Flowering Plants (low importance)

A high intensity of management usually means that holiday parks are rarely rich in native wildflowers unless there are remnants of previous semi-natural habitats. The locally rare Slender Trefoil *Trifolium micranthum* has been recorded at a holiday park in Newton Stewart.

4. Environmental, Economic & Social Importance of Biodiversity

- Adding biodiversity features to holiday parks and caravan sites can considerably increase their appearance and attractiveness to visitors.
- Trees and shrubs can be used to screen unsightly features such as bin stores, and can add to the privacy of the site.

5. Factors affecting the Habitat

- Most holiday parks were created on farmland are still **relatively young in ecological terms**. They therefore have not yet developed many mature trees or other habitats.
- Biodiversity management is not simply less management. It requires new **skills and training** for maintenance staff, which may not be available in-house.
- Many park visitors are urban based and biodiversity features such long grass, log piles and scrub may be **perceived as untidiness**.

6. Strategic Actions

6.1 Recent and current activity

- In 2007, 11 holiday parks and caravan sites in Dumfries & Galloway held **David Bellamy Conservation Gold Awards** for their wildlife and environmental management.
- A number of holiday parks and caravan sites have **wildlife interpretation**, including information panels, leaflets, guided walks and family events.
- Several parks have contributed to the **Dumfries & Galloway Wildlife Festival**.

6.2 Other recommended actions

- Encourage parks to enter for **environmental awards.**
- **Provide training** in biodiversity management for maintenance staff.

WALLS & BUILDINGS

Priority Action (WB1)

Encourage greater public awareness of the value of walls and buildings for biodiversity by publishing a guide to the species and management.
Target: Publish and distribute to architects, builders and householders by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership.

1. Habitat Description

1.1 Physical Characteristics

The biodiversity of walls and buildings is influenced by their location. Farm buildings in the countryside often have different species to those in towns, especially if they are located close to semi-natural habitats such as woodland, and walls and buildings on the coast have different species again. However, this does not mean that walls and buildings in towns and villages are without interest.

The biodiversity of exterior **wall faces**, whether free-standing or part of a building, is strongly dependent upon construction materials, location and aspect. The former influences chemical composition and physical structure of walls; the latter two largely control their microclimate. **Wall ledges**, where they exist, add another dimension to biodiversity, providing a habitat for species of plants and animals that are unable to survive on vertical faces.

Roofs offer a slightly different habitat to walls – they are usually composed of a different material and this, together with the angle of slope, influences biodiversity interest. Slate and tile roofs offer many small holes and crevices that offer opportunities for several species.

The **interior spaces** of buildings provide a further habitat for biodiversity. Most species occupy the spaces not permanently occupied by people, but a few have shared our living spaces ever since we first constructed them.

1.2 National and International Context

Western Britain contains some of the finest wall vegetation in Europe, as a result of a mild, wet climate. Only north-western France has a comparable flora.

2. Dumfries & Galloway Status

2.1 Recent Trends

Modern materials provide fewer external opportunities for biodiversity, though just as many, if not more, internal habitats. Numerically, most of the region's walls and buildings comprise of 20th century houses.

2.2 Current Distribution

Outside of the main urban centre of Dumfries, walls and buildings are relatively evenly spaced in the lowlands, becoming less common in the uplands.

2.3 Site Examples

There is a wide range of buildings and walls in Dumfries & Galloway. Some of the most important for biodiversity includes castles, churches and other historic walls and buildings, and farm steadings.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with walls and buildings, and the following action plans may also contain relevant information: Traditional Field Boundaries, Bridges and Tunnels, Industrial and Post-industrial Sites, Urban Watercourses and Wetlands.

3. Importance for Associated Species

3.1 Mammals (very high importance)

Long-eared Bats prefer older buildings close to woodland. Cally Woods, June 2000. (Peter Norman)

Large numbers of bats rely on buildings, especially roofs, to provide them with shelter for breeding, roosting and hibernating. Few species hang in exposed positions - most tuck themselves out of sight, so their presence may not be obvious. The design and construction of buildings influences the type of bats present. For example Long-eared Bats *Plecotus auritus* usually

fly around roof spaces prior to leaving the building to hunt in woodland. Therefore they are most frequently found in older, rural buildings. Conversely, Pipistrelle Bats *Pipistrellus pipistrellus* and *P. pygmaeus*. are frequently found in new houses in urban areas. Of Dumfries & Galloway's eight species of bat, only the Noctule *Nyctalus noctula* does not make extensive use of buildings.

Although other wild mammals may occasionally use buildings, none are of significant conservation importance in Dumfries & Galloway.

3.2 Fungi and Lichens (high importance)

Lichens are common on many **wall faces**, but species composition is strongly influenced by the wall substrate and associated chemical attributes and textures. In south east England the rare Churchyard Lecanactis lichen *Lecanographa grumulosa* is entirely restricted to limestone walls of medieval churches and castles. It has been recorded in Dumfries & Galloway, but only from natural rock faces on the coast. A few non-lichenised microfungi also grow on walls, but they are not of high conservation importance.

3.3 Non-flowering Plants (high importance)

Ferns, liverworts, mosses and algae are more tolerant of lower light levels that other plants and therefore frequently dominate shadier **wall faces**. Species include Wall Rue *Asplenium ruta-muraria,* Maidenhair Spleenwort *Asplenium trichomanes* and Revolute Beard-moss *Pseudocrossidium revolutum* on lime-mortared walls. Wall Screw-moss *Tortula muralis* is the commonest moss on many mortared or base-rich walls, both brick and stone, and can tolerate some shade and pollution. It also grows on concrete, roof tiles and other man-made structures, but is rarely found away from human habitation. Rough-stalked Feather-moss *Brachythecium rutabulum* is typical on wall-tops.

Grey-cushioned Moss Grimmia pulvinata, common on urban walls. (Peter Norman)

Joints and cracks on otherwise smooth slate and tile **roofs** enable species such as Capillary Thread-moss *Bryum capillare* and Grey-cushioned Grimmia *Grimmia pulvinata* to get a hold, whilst Great Hairy Screw-moss *Syntrichia ruralis* might be found on flat asphalt roofs.

Churches and castles are important habitats for non-flowering plants in many parts of Britain, but in Dumfries & Galloway they are not constructed on the most valuable building stone (limestone), and are usually located in areas that have many natural rock outcrops. As a result they rarely support notable species.

3.4 Flowering Plants (medium importance)

A few species, such as Biting Stonecrop *Sedum acre,* favour the tops of walls, but the upper and middle zones of **wall faces** generally support the most distinctive vegetation, including Herb Robert *Geranium robertianum* and the introduced Ivy-leaved Toadflax *Cymbalaria muralis* and Yellow Corydalis *Corydalis lutea*. Another introduced species Fairy Foxglove *Erinus alpinus* is known from a few walls, including the abbeys at Glenluce and Dundrennan, whilst Wallflower *Erysimum cheiri* was lost from the walls of Sweetheart Abbey through cleaning by the Ministry of Works in the 1950s. Navelwort *Umbilicus rupestris and* Pellitory-of-the-wall *Parietaria judaica* are locally rare native species, growing on just a few walls. Walls with lime mortar are especially rich, with even granite walls supporting lime-loving plants.

Yellow Corydalis, a native of the Alps, on sandstone wall at Castledykes Park, Dumfries. September 2007. (Peter Norman)

Lower zones and wall bases usually receive excessive nutrients and moisture, and support a less interesting flora, whilst woody species are able to establish on poorly maintained walls with missing mortar.

3.5 Invertebrates (medium importance)

Old walls provide good nesting sites for bees, wasps and ants if the mortar is soft enough for burrowing. Indeed relict populations of some species may survive only in walls after loss of their natural nesting sites. Ants play an important part in the seed dispersal of many wall plants.

The Zebra Spider *Salticus scenicus*, a jumping spider that hunts on sunny wall faces, occurs more frequently along the Solway coast than in other parts of Scotland, and the first Scottish record of a large long-legged spider *Tegenaria parietina* came from the **interior space** of a house in Dumfries in 2006.

Swallows are almost entirely reliant on buildings for nest sites. (Gordon McCall)

3.6 Birds (medium importance)

House Martins *Delichon urbica* make use of the underside of wall **ledges**, especially eaves, to build their nests. Barn Owls *Tyto alba*, Swallows *Hirundo rustica* and Swifts *Apus apus* rely much more on **interior spaces**, the first two predominantly in unoccupied rural buildings, and the latter in the **roofs** of urban buildings.

4. Environmental, Economic & Social Importance of Biodiversity

- A covering of flowering plants, mosses and lichens add to the aesthetic appeal of many walls and buildings.
- Some lichens break down stone, but there is evidence that others protect some types of stone by providing a shield against water erosion.

5. Factors affecting the Habitat

- Over-zealous **removal of all plant species** reduces biodiversity.
- The **use of biocides** to control mosses and lichens. This is rarely necessary and should be limited to very exceptional circumstances.
- Certain mosses and lichens have declined as a result of the **reduction in the use of lime mortar.**
- If not sympathetically carried out, **roofing repairs** may reduce bat habitat and directly lead to the death of some bats. In such circumstances a criminal offence may be committed.
- **Bat roosts may be unknowingly destroyed**, possibly resulting in the death of those bats using the roost at the time.
- There is a **negative perception** of the wildlife associated with built habitats, including mice, rats, pigeons and roof nesting gulls, although these habitats also support a number of other species of conservation value including Barn Owls, Swifts and Swallows.

6. Strategic Actions

6.1 Recent and current activity

- It is a legal requirement that any building works take account of known bat roosts, but only a small proportion of the roosts have been discovered or recorded. **SNH** therefore request surveys to be completed where there is a risk to bats.

6.2 Other recommended actions

- **Provide advice** on incorporating design for biodiversity into new buildings and other structures, such as ‘bat bricks’ and bird nesting platforms.
- **Survey and record** flora on walls.
- **Consult** SNH prior to re-roofing if there is any likelihood of bats being present, or if bats are found during roofing work.
- Ensure **nesting Barn Owls are protected** during barn conversions or other relevant building repairs, and subsequent provision is made for them.
- **Consider turf and *Sedum* roofs** on appropriate new buildings.

PORTS, HARBOURS & MARINAS

Priority Action (PHM1)

Encourage greater awareness of biodiversity and environmental issues amongst the users and managers of ports, harbours and marinas by providing wildlife information/interpretatio.
Target: Interpretation at 3 sites by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership/Solway Firth Partnership.

Seaweed at Isle of Whithorn Harbour, April 2008. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Ports, harbours and marinas, by their very nature, are located in sheltered coastal waters, but this shelter is usually enhanced by **harbour walls**. The seaward sides of these walls are poorest in terms of species composition as they are relentlessly battered by waves, sand and pebbles. Hard sea defences provide a similar habitat. The quieter, siltier and more turbid conditions of the inner harbour walls are usually richer in species. These are usually constructed from stone, but like the rocky shores they resemble, gradations of hardness are found from concrete and iron to wood. These structures also provide secure moorings for vessels, but in marinas (where there are usually many small boats to accommodate) this is usually augmented by **floating pontoons**.

2. Dumfries & Galloway Status

2.1 Recent Trends

Commercial and fishing vessels remain at a low level, but there has been a recent increase in recreational craft. Both of the region's marinas are at full capacity. At the time of writing it is planned to relocate all ferry traffic from Stranraer to Cairnryan, and increase recreational use of Stranraer.

2.2 Current Distribution

The largest of the Dumfries & Galloway's ports and harbours are in the west of the region. There are few hard sea defences of any extent in the region.

2.3 Site Examples

The principal commercial ports in Dumfries and Galloway are **Stranraer** and **Cairnryan** in Loch Ryan, which both deal principally with ferry traffic to Ireland. Small harbours are found in several towns and villages including **Portpatrick, Port Logan, Drummore, Port William, Isle of Whithorn, Garlieston, Kirkcudbright** and **Annan**. Most support a combination of small inshore fishing vessels and recreational craft, though a small offshore shellfishing fleet is based at Kirkcudbright. Other harbours in the region now receive little or no traffic. Marinas are present at **Kirkcudbright** and **Kippford**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with ports, harbours and marinas, and the following action plans may also contain relevant information: Intertidal Rocky Shores, Walls and Buildings.

3. Importance for Associated Species

3.1 Birds (medium importance)

Apart from gulls, Black Guillemots *Cephus grylle* are the birds most closely associated with harbours. They nest in Portpatrick **harbour walls**. Offshore structures that are less susceptible to disturbance can be very valuable for nesting birds. The abandoned Mullberry

Harbour at Garlieston is one of the biggest breeding Cormorant *Phalacrocorax carbo* colonies in the region, whilst terns (as well as Black Guillemots) have nested on the disused South Deep jetty at Cairnryan.

Black Guillemots nest in several harbours and ports. (Gordon McCall)

3.2 Non-flowering Plants (medium importance)

Typical seaweeds of **harbour walls** include Spiral Wrack *Fucus spiralis*. Another seaweed *Callithamnion tetragonum* is mostly restricted to kelp fronds the west coast of Britain including Wigtownshire, but regularly occurs on marina **pontoons** and may move into such a habitat in Dumfries & Galloway.

3.3 Invertebrates (medium importance)

The invertebrates of ports, harbours and marinas are not particularly specialised, usually reflecting those found on adjacent shores of a similar sediment type. **Harbour walls** support a similar range of species to rocky shores, often under the curtain of seaweeds, including Common Limpets *Patella vulgata,* Barnacles *Balanus crenatus*, Beadlet Anemones *Actinia equina* and another anemone *Sagartia elegans*. Their predators are also similar, including Shore Crabs *Carcinus maenas* and Harbour Crabs *Liocarcinus depurator*. The latter is not restricted to harbours despite its name. The Shipworm *Teredo nivalis* may bore into wooden structures.

3.4 Flowering Plants (low importance)

There are no flowering plants found in the waters of ports, harbours and marinas. Some species are able grow on the upper parts of **harbour walls** and on land-based structures. The typical species of inland walls are augmented by maritime specialists such as Common and Danish Scurvygrass *Cochleria officinalis & C. danica*, Thrift *Armeria maritima* and Buck's-horn Plantain *Plantago coronopus.*

3.5 Fishes (low importance)

Though several species of fish enter harbours and find productive feeding areas around walls and other structures, species composition is the same as adjacent coastal areas.

3.6 Mammals (low importance)

Despite their name, Harbour Porpoises *Phocoena phocoena* rarely visit the shallow waters of inner harbours, though they may be seen close to the harbour entrance. Seals are also infrequent visitors, but Otters *Lutra lutra* may visit on a nightly basis.

4. Environmental, Economic & Social Importance of Biodiversity

Wildlife and interpretation enhances ports, harbours and marinas for passengers and visitors.

5. Factors affecting the Habitat

Risks of accidental oil spillage or other **pollution** are greater in ports, harbours and marinas.

6. Strategic Actions

6.1 Recent and current activity

- **Kirkcudbright Marina** was the first in Scotland to receive a Blue Flag award.
- **Wigtown Harbour** is a principal access point and car park for Wigtown Bay Local Nature Reserve, with wildlife interpretation and a bird bide.

6.2 Other recommended actions

- **Raising awareness** of biodiversity amongst users and managers of ports, harbours and marinas would benefit not only the wildlife of these sites, but would encourage increased reporting of marine species.

ROADS & VERGES

Priority Action (RV1)

Provide special management of roads and verges at sites known to be important for biodiversity through designation of new Conservation Verges.
Target: 10 new Conservation Verges by 2015.
Lead Partner: Dumfries & Galloway Council/Amey Highways.

1. Habitat Description

1.1 Physical Characteristics

Modern road construction techniques and traffic levels mean that the **carriageway** is an inhospitable habitat for virtually all wildlife, other than on very minor roads. **Verges** offer more opportunities. They usually consist of improved grassland created during, or shortly after, construction of the road. However, some stretches of minor roads may pass through semi-natural habitats such as unimproved grassland, heathland or native woods, which now constitute the verge. Both are subject to operational safety requirements with regard to cutting and other management and both receive, as an unintentional result of their location, relatively high levels of pollutants such as de-icing salt, oil and vehicle emissions.

Danish Scurvygrass, a plant fast expanding its range due to road salting. A75 near Annan, April 2007. (Peter Norman)

Roadside **ditches** need to have a water level well below the ground level in order to keep the surrounding land dry. They are therefore often deep and steep sided.

Traditional field boundaries on roadsides are covered in a separate plan.

2. Dumfries & Galloway Status

2.1 Recent Trends

Increased concern regarding the wider environmental impact of roads and road building in recent decades has helped to heighten awareness about biodiversity issues on roads. As a result, much greater thought has been given to such issues.

2.2 Current Distribution

There are some 2,900miles (4,666km) of road in Dumfries & Galloway, most of which has a verge. The major roads are located in the lowlands and river valleys with fewer, more minor roads in the uplands.

2.3 Site Examples

The only section of motorway in the region is the **A74(M)** through Annandale. The **A75** Euroroute traverses most of the region's river valleys that are regular movement routes for many species.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with roads and verges, and the following action plans may also contain relevant information: Neutral Grasslands, Scrub Woods, Traditional Field Boundaries, Urban Trees, Bridges and Tunnels.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Most road **verges** that are important for wildflowers of are remnants of habitats that existed before the road was constructed, especially neutral grasslands. Greater Broomrape *Orobanche rapum-genistae*, which is rare in Scotland but known from a few sites in the region including a verge in Dumfries, is associated with Gorse and Broom scrub.

On minor roads, flowers such as Wild Thyme sometimes grow directly on the carriageway. The Machars, July 1999. (Peter Norman)

A few plants occur on verges, not because they were present prior to the road, but because road management has encouraged them. Perhaps the best example

is Danish Scurvygrass *Cochlearia danica*, a plant of the cliff-tops, sand dunes and sea walls that first started appearing inland on the central reservations of motorways and dual carriageways in the late 20th century as a result of salt treatment. The distribution map in the New Atlas of British and Irish Flora (2002) clearly shows this plant along the route of the A74(M), but it has since spread westwards along the A75 to Dumfries. Although now frequent on single carriageways, it is seldom seen below A-class roads.

3.2 Invertebrates (medium importance)

The first Scottish colony of Narrow-bordered 5-spot Burnet Moth *Zygaena lonicerae* subsp. *latomarginata* was found on a verge of the A711. It remains the only site for this species in Dumfries & Galloway.

Narrow-bordered 5-spot Burnet moth. Dalskairth road verge, July 2004. (Peter Norman)

3.3 Mammals (medium importance)

Other than mice and voles, roads and verges support few mammal species. However roads are a significant cause of death for several species of conservation concern, including Hedgehogs *Erinaceus europaeus,* Otters *Lutra lutra* and Badgers *Meles meles.* Fortunately it currently appears that these deaths are not limiting local populations.

3.4 Reptiles and Amphibians (medium importance)

There are recorded instances of reptiles basking on warm **carriageways** of very minor roads, but more often roads pose a threat to reptiles and amphibians. Toads in particular tend to use the same routes between feeding areas and breeding ponds and on damp evenings at certain times of the year can be highly susceptible to traffic. Nevertheless populations of other species prosper on certain **verges**, including Slow Worms *Anguis fragilis* on the A713 beside Loch Ken.

3.5 Birds (medium importance)

Rooks *Corvus frugilegus*, Crows *C. corone* and sometimes Buzzards *Buteo buteo* attempt to feed on carrion on the **carriageway.** Few species nest on the **verge** itself, though Oystercatchers *Haematopus ostralegus* are recorded doing so most years. A number of birds, including Barn Owls *Tyto alba*, are regularly killed by traffic as they hunt along verges or fly over the road.

3.6 Non-flowering Plants (low importance)

Unlike flowering plants, there are few salt and heavy metal-tolerant mosses that are specialists of road verges.

3.7 Fungi and Lichens (low importance)

Road verges are rarely of significant interest for fungi, although a limited range of nitrogen-tolerant species occur, such as Shaggy Ink-cap *Coprinus comatus* and the Horse Mushroom *Agaricus arvensis*. Potentially of more importance are upland verges with unimproved grassland.

Pestle Puffball Handkea excipuliformis by the A762 near Mossdale. August 2008. (Peter Norman)

4. Environmental, Economic & Social Importance of Biodiversity

- Road verges that are high in biodiversity, especially wildflowers, add to the landscape and enhance the area for tourists.
- Some types of roadside vegetation reduce noise and pollution from traffic.

5. Factors affecting the Habitat

- **Road safety** must always take priority in the management of roadside verges and hedges.
- **Fragmentation** of habitats as a result of roads acting as barriers to movement.

- A high incidence of wildlife **road kills** in Dumfries & Galloway involving mammals and birds of conservation importance, including Otters, Badgers, Red Squirrels and Barn Owls. Other species can be affected by noise, movement or light disturbance.
- Excessive **grass cutting, shrub and hedge brashing** can change habitat structure.
- **Over-use of chemicals** to control weeds can affect non-target species, and run-off of chemicals and oil can pollute watercourses.
- Road construction and maintenance can result in **alterations to the natural drainage pattern** of a locality.
- Treatment of verges on new roads or following carriageway alterations may not benefit biodiversity. **Top-soiling and inappropriate planting** produces poor results. Usually the outcome is a missed opportunity for biodiversity, but in some cases can lead to potentially invasive species. For example, Bird's-foot Trefoil is usually a valuable foodplant for butterflies, but much of it on the A75 is a non-native vigorous subspecies of limited value that has spread from introduced seed mixes.
- **Flailing roadside scrub** may look untidy but has little detrimental impact on biodiversity as long as it is not carried out in the bird breeding season.

6. Strategic Actions

6.1 Recent and current activity

- **The Scottish Executive** drafted a Trunk Road Biodiversity Action Plan for trunk roads across Scotland.
- **Dumfries & Galloway Council** drafted a Roadside Biodiversity Action Plan in 2000 and has implemented most of its recommendations. As part of this, several conservation verges have been identified in the region and received special management.

6.2 Other recommended actions

- **Enhance populations** of nationally and regionally uncommon plants and invertebrates that occur on road verges through modifications to management or timing of management.
- **Identify blackspots** for wildlife road kills.
- Include proactive design measures to safeguard against animal kills on new roads such as the installation at appropriate locations of **animal underpasses and culverts**.
- Implement measures to safeguard against animal kills on existing roads, by carrying out works to encourage animals to use existing culverts, such as **fencing, reflectors and culvert modification**.

Cow Parsley display on verge by minor road near Dundrennan. June 2006. (Peter Norman)

RAILWAYS

Priority Action (RA1)

Assess the biodiversity of the rail network in Dumfries & Galloway by providing safety training to enable access for volunteer surveyors.
Target: Survey 10 selected sites by 2015.
Lead Partner: Network Rail/Dumfries & Galloway Environmental Resources Centre.

Trees and shrubs beside working railway, Dumfries. August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Virtually all of Britain's railways were established in the Victorian age of steam. Gradients were minimised to allow steam trains to operate at maximum speed; **cuttings** were excavated through higher ground and **embankments** constructed across low ground. The orientation of these features exerts a significant influence on their micro-climate, and therefore their biodiversity; the sunnier south-facing embankments support different species to north-facing slopes or shady cuttings. Although less obvious in the landscape, a number of other habitats were created: **ballast** on the track bed and drainage **ditches** by the rail side. The masonry of platforms, walls and bridges, and the highly specialised habitat of tunnels are covered by a separate action plans.

Some embankments were planted with trees, occasionally grass, to prevent them washing away, but the majority of wildlife colonised naturally from the surrounding countryside which, at the time of railway construction, was less affected by agricultural intensification. Therefore many areas along the railway line contain communities that are the remnants of habitats that have now almost disappeared in the surrounding area due to changes in land use. Furthermore, the rail network provides natural corridors through the intensively-managed agricultural areas, linking other habitats such as woods and grasslands.

The turbulence created by the trains was responsible for the spread of some species, whilst management of vegetation exerted a significant influence on biodiversity. Initially this involved regular hand cutting of vegetation growing through the ballast, and removal scrub on the rail sides to prevent it being ignited by sparks. Later it involved greater use of herbicides, but regular disturbance has always been and remains a feature of working railway lines.

1.2 National and International Context

There are over 30,000 hectares of lineside vegetation along the 21,000 miles of the national rail network. There is approximately 125 miles of working railway line in Dumfries & Galloway, and at least 160 miles of disused railway.

2. Dumfries & Galloway Status

2.1 Recent Trends

Over the last 10 years, a number of short stretches have been turned into walking and cycling routes, especially in Dumfries.

2.2 Current Distribution

Working railway line in Dumfries & Galloway is restricted to the lines from Carlisle to Glasgow via Dumfries, Carlisle to Glasgow via Lockerbie and Stranraer to Glasgow. The majority of the disused railway lines are still discernible on the ground.

A disused railway line providing habitat linkages through an urban area. Caledonian Cyclepath, Dumfries, August 2007. (Peter Norman)

2.3 Site Examples

The **Caledonian Cycleway** in Dumfries is the longest stretch of disused railway in the region to be turned into a walking/cycling route.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with railways, and the following action plans may also contain relevant information: Neutral Grasslands, Acid Grasslands, Inland Rock Outcrops Scrub Woods, Traditional Field Boundaries, Bridges and Tunnels, Walls and Buildings, Industrial and Post-industrial Sites.

Dog Rose, a typical plant of railway banks. (Peter Norman)

3. Importance for Associated Species

3.1 Flowering Plants (medium importance)

Studies have found around 70% of the native British flora from railway land. **Ballast** is typically colonised by a range of plants that are resistant to moisture stress, such as Procumbent Pearlwort *Sagina procumbens*. On working lines, these are regularly removed, allowing the process of colonisation to start all over again, but if the line ceases to be used, a grassland habitat forms that can be very species-rich. On acidic sites, a Heather *Calluna vulgaris* community may develop, but on neutral sites a more diverse, taller vegetation dominates. This includes species such as Red Fescue *Festuca rubra*, Tansy *Tanacetum vulgare,* Common Toadflax *Linaria vulgaris* and Black Knapweed *Centaurea nigra.* Rare species recorded from railway lines in Dumfries and Galloway include Common Wintergreen *Pyrola minor.*

Cuttings tend to support the richest grassland, due to their slopes being composed largely of unfertilised soil. Drifts of Rosebay Willowherb *Chamerion angustifolium,* and Ox-eye Daisy often dominate long sections, but less common species such as Meadow Crane's-bill *Geranium pratense* and Common Spotted Orchid *Dactylorhiza maculata* are also found. Eventually scrub invades. One of the first woody species to colonise, particularly in more urban areas, is Buddleia *Buddleja davidii*, but Hawthorn *Crataegus monogyna*, Blackthorn *Prunus spinosa* and Elder *Sambucus nigra* often form dense thickets.

3.2 Invertebrates (medium importance)

A number of butterflies, such as Common Blue *Polyommatus icarus* and Wall *Lasiommata megera*, are found on railway lines. The bare ground of the **ballast** and some **embankments** is especially valuable for them and their foodplants, whilst cuttings (as long as they are not too shady) provide shelter.

3.3 Reptiles and Amphibians (medium importance)

Slow Worms *Anguis fragilis* and Adders *Vipera berus* bask on ballast and south-facing embankments that heat up quickly, and make use of the surrounding vegetation for shelter.

3.4 Birds (medium importance)

Although none of the rarer species of bird is dependent on railway lines, there is a diverse range of birdlife found on the network. Typical species are those associated with scrub, such as Dunnocks *Prunella modularis,* Common Whitethroats *Sylvia communi,* Willow Warblers *Phylloscopus trochilus,* Bullfinches *Pyrrhula pyrrhula,* and Linnets *Carduelis cannabina.*

Goldfinch, a colourful species that feeds on thistle and other seeds. (Gordon McCall)

3.5 Non-flowering Plants (medium importance)

Field Horsetail *Equisetum arvense* is a frequent invader of **ballast**, being somewhat resistant to herbicides. Other typical ballast species include Capillary Thread-moss *Bryum capillare* and Common Cord-moss *Funaria hygrometrica*, but it has been known to support species more typical of upland areas, including Green Mountain Fringe-moss *Racomitrium fasciculare.* Shady Earwort *Scapania umbrosa* and several other liverworts are found in deep **cuttings**

3.6 Mammals (low importance)

Many mammals are found on railway lines, and several use them as corridors to move through the countryside, but no species are dependent on this habitat.

4. Environmental, Economic & Social Importance of Biodiversity

The biodiversity of the railway network, both working and disused, adds to the interest and enjoyment of users and contributes to the landscape.

5. Factors affecting the Habitat

- Safety obligations are of paramount importance on working railway lines. Biodiversity management of these areas must be **compatible with safety issues**.
- Safety restrictions restrict access to working railway lines, which means that **few wildlife surveys** have been carried out.
- In many areas, particularly on disused lines, **scrub growth** has affected species rich grassland.

6. Strategic Actions

6.1 Recent and current activity

Network Rail has developed a Biodiversity Action Plan for their UK operations.

BRIDGES & TUNNELS

Priority Action (BT1)

Assess bridges in need of remedial work to allow unimpeded passage of fish by compiling, and making available, an inventory.
Target: Complete by 2012.
Lead Partner: District Salmon Fisheries Boards.

Priority Action (BT2)

Install integral bird and/or bat boxes into bridges during any scheduled maintenance or upgrading work.
Target: 10 bridges by 2015.
Lead Partner: Dumfries & Galloway Council.

Bridge over Nith at Thornhill. (Paul McLaughlin)

1. Habitat Description

1.1 Physical Characteristics

The date of construction of bridges and tunnels greatly influences their design, the materials used in construction, and therefore their physical characteristics. Early bridges were simple wooden constructions but few are in use today, other than short footbridges. Nineteenth century bridges were largely constructed of stone or brick, and many of these are still in use. The range from short single-span bridges to large **viaducts**, consisting of a series of short masonry arched spans supported on towers. The type of stone and mortar, and the number and position of ledges/holes influences their biodiversity. More recent bridges have mostly been constructed of concrete, including **flyovers** that support a main road, often crossing another road. They generally have fewer opportunities for biodiversity. A few metal bridges have also been constructed.

Whether the bridge crosses a watercourse, a road, a railway or some other obstacle affects its physical characteristics. River bridges experience more humid conditions, whilst those over roads and operational railways are affected by emissions. Orientation is also important, with the south facing, exposed side of the bridge experiencing greater extremes of light and temperature, in comparison to the north-facing or shadier areas of the bridge.

Though tunnels are also influenced by their age, construction techniques, materials and location, they have very different physical characteristics to bridges. This largely results from a more stable temperature regime and permanently dark, humid conditions within the tunnel.

2. Dumfries & Galloway Status

2.1 Recent Trends

A number of new bridges, particularly footbridges, have been built in recent years. However, of much more significance to biodiversity, is the large number of bridges that have been upgraded.

2.2 Current Distribution

There are more than 1,400 bridges in Dumfries and Galloway, spread throughout the region.

2.3 Site Examples

A number of large viaducts are found in the region, such as at **Big Water of Fleet** (1861), near Gatehouse. Notable bridges include **Devorgilla's Bridge** (c1432) and **Tongland Bridge** (1804-8). The latter supports the largest colony of House Martins in the region. However, many of the smaller bridges are equally, if not more important from a biodiversity perspective. There is only one major tunnel in Dumfries & Galloway, slightly over 1km in length, on the operational railway line between Dumfries and Kirkconnel, near Drumlanrig.

Virtually every compartment under the ledge of Tongland Bridge has a House Martin nest each summer. (Peter Norman)

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with bridges and tunnels, and the following action plans may also contain relevant information: River Headwaters, Lowland Rivers and Backwaters, Lowland Burns and Ditches, Exposed River Shingle, Walls and Buildings, Urban Watercourses and Wetlands, Reservoirs.

3. Importance for Associated Species

3.1 Fishes (high importance)

Freedom of movement, both upstream and downstream, is essential for the survival of many species of fish, and this can be severely affected by bridges. Both young and adults of migratory species such as Salmon *Salmo salar*, Sea Trout *Salmo trutta* and Eels *Anguilla anguilla* travel hundreds of miles between freshwater spawning grounds and the sea, but even non-migratory species require a variety of aquatic habitats and may travel several miles up and down a watercourse.

3.2 Mammals (high importance)

Bridges and tunnels are important hibernation and roost sites for most species of bat, with Daubenton's Bat *Myotis daubentonii* particularly associated with bridges. Otters *Lutra lutra* frequently mark their territory with spraints (droppings) under bridges.

3.3 Fungi and Lichens (medium importance)

The lichen flora of bridges is, as on other walls, strongly influenced by the wall substrate and associated chemical attributes and textures. A wide range of species is found.

3.4 Non-flowering Plants (medium importance)

The masonry of bridges and tunnels was particularly suitable for a range of ferns during the steam age, when the additional moisture encouraged growth wherever trains were regularly halted. For example, Rusty-back *Ceterach officinarum* occurred on Little Water of Fleet Viaduct prior to its demolition. Others ferns still persist. The lower sections of bridges over water also support a range of mosses, liverworts and algae.

3.5 Birds (medium importance)

Dippers *Cinclus cinclus* regularly nest under bridges that span watercourses. The largest House Martin *Delichon urbica* colony in Dumfries & Galloway occurs on Tongland Bridge.

3.6 Invertebrates (low importance)

Construction of a new bridge over a river may impact on aquatic invertebrates as much as fish. A diving beetle *Bidessus minutissimus*, at one of its few UK sites, is believed to have been affected by construction of a flyover over the River Nith for the Dumfries bypass.

3.7 Flowering Plants (low importance)

A similar range of flowering plants is found on bridges as on other walls.

4. Environmental, Economic & Social Importance of Biodiversity

Bridges that cross watercourses and affect fish passage impact on the economic and recreational benefits of local fisheries.

5. Factors affecting the Habitat

- Fish passage at river crossings is important in the planning, design, installation and upgrading of bridges. Improperly designed culverts and other river crossing structures act as a barrier to fish movement. Problems include inadequate water depth, excessive water velocities, vertical barriers and works carried out at an inappropriate time of year.
- Repointing of masonry bridges not only reduces opportunities for roosting bats, but has the potential to entomb and kill any bats using the structure at the time of the work being carried out.

6. Strategic Actions

6.1 Recent and current activity

- A pro-active approach has been taken on a number of bridges being renovated by **Dumfries & Galloway Council**, with a check for bats being carried out by a countryside ranger prior to work commencing.
- Renovation of the disused Goldilea Viaduct involved special measures to cater for Common Wintergreen plants and bats that were found on the bridge.
- **Forestry Commission Scotland** has built bat and bird boxes into the construction of bridges for forest roads.
- In parts of Europe, specially designed green bridges have been constructed over major roads specifically to enable wildlife to cross.

6.2 Other recommended actions

- **Incorporate well-designed and effective wildlife underpasses** into all new roads wherever required. If the location is appropriate, consider more effective structures such as green bridges.
- **Assess bridges** in need of remedial work to allow unimpeded passage of fish.
- Give consideration, where feasible, to the **installation of integral bird and/or bat boxes** into bridges during scheduled maintenance or upgrading work.

An old, unpointed bridge with many opportunities for roosting bats. Kirkconnell Bridge, Ringford. May 2008. (Peter Norman)

INDUSTRIAL & POST INDUSTRIAL SITES

Priority Action (IPIS1)

Encourage industrial businesses to manage their landholdings for biodiversity through preparation of a site Biodiversity Action Plan.
Target: Encourage 1 industrial business to prepare plan and begin implementation by 2015.
Lead Partner: Dumfries & Galloway Biodiversity Partnership/Business Environment Partnership.

Former lead mine at Wanlockhead. August 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Bownfields are sites that have previously been developed, usually for industrial use but sometimes other land-uses. In the early post-industrial years, sites are characterised by an abundance of bare ground, often mixed with building stone, bricks, concrete, metal and other artificial substrates. Several scarce and threatened open vegetation communities occur here, and over time may develop into areas of grassland, heathland and scrub, but the habitat can often persist for decades without active intervention because of the severity of the chemical or physical properties of the soil. **Second World War** sites, including abandoned airfields, munitions factories and military ranges often support similar habitats to post-industrial brownfields.

Deep mines have little ecological interest, but are often associated with extensive surface features, including ponds and **mine spoil** (bings) that can be of value, depending on their physical and chemical composition, and any restoration techniques employed. The combination of toxic metal concentrations and low nutrients, produces an extreme environment for plant colonisation, but species that are tolerant of such conditions can thrive, free from competition. Shallow disused **mine shafts** share similar physical characteristics to natural caves, and can support specialised flora and fauna. Open cast mines are included in the habitat action plan for quarries and mineral workings.

1.2 National and International Context

In 2006 there was 7,480ha of derelict land in Scotland, defined as damaged by development and incapable of development for beneficial use without rehabilitation. 216ha (2.9%) of this was in Dumfries and Galloway.

2. Dumfries & Galloway Status

2.1 Recent Trends

A number of further industries have become established in recent decades, including timber and food processing. Coal mining remained important in the Sanquhar-Kirkconnel field until the 1960s. It has since recommenced, but employing open cast, rather than deep mining methods. A number of agencies have been involved in the provision of mainly greenfield light industrial/business sites since the 1950s.

2.2 Current Distribution

Much of the post-industrial land in Dumfries and Galloway is associated with military sites. Although these are largely restricted to lower altitudes, there are also some post-industrial sites in the uplands. Active industrial sites are predominantly lowland, usually close to larger settlements.

2.3 Site Examples

The site of a former explosives factory at **Royal Ordnance Powfoot** (SSSI) retains much of the old infrastructure, such as abandoned stores, railway sidings and lagoons. The wide range of habitats from wetlands, through grasslands and heaths to scrubby woodland, combined with the sandy substrate, make the site outstanding for amphibians. Ponds, boardwalks and wildlife interpretation have been installed on a community nature reserve at **Gatehouse Brickfields**.

Wanlockhead (SSSI) contains the most important lead-zinc deposits in Scotland, which were actively worked for over 400 years. The area contains old mine workings and spoil heaps. The lead mines at **Blackcraig** have influenced the ecology of a range of habitats. The adjacent woods, now a reserve of the Scottish Wildlife Trust, were described on the mine plan of c1760 as 'Oak wood fit for all kinds of work underground'. They would have been managed and modified by the miners.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with industrial and post-industrial sites, and the following action plans may also contain relevant information: Walls and Buildings, Railways, Quarries and Mineral Workings.

3. Importance for Associated Species

3.1 Invertebrates (very high importance)

Brownfields are probably the single most important invertebrate habitat away from semi-natural habitats. Sites can support important invertebrate communities, including rare species of beetles, butterflies, moths, bees and wasps that require bare substrate, sandy burrowing or nesting sites, and nectar sources. Common 'weeds' such as Pineappleweed *Matricaria discoidea* are important to invertebrates as larval foodplants and nectar supplies for adults.

Rhizocarpon petraeum, one of the many lichens on mine spoil at Wanlockhead. August 2007. (Peter Norman)

3.2 Fungi and Lichens (high importance)

Mine spoil is colonised by a number of lichens tolerant of the extreme conditions. A critically endangered nationally rare lichen *Gyalidea roseola* was found on a block of calcareous sandstone amongst rubble in the lead mining workings at Wanlockhead in 2006, its only current UK site (previously recorded only in Argyll in 1962).

3.3 Non-flowering Plants (high importance)

Mine spoil can support rare bryophytes that are tolerant of heavy metals.

3.4 Mammals (high importance)

Disused **mine shafts**, including some at Wanlockhead, provide the most important bat hibernation sites so far discovered in Dumfries & Galloway, although this undoubtedly partly reflects the difficulty in locating tree hibernacula.

3.5 Reptiles and Amphibians (high importance)

Natterjack Toads *Epidalea calamita* breed in ponds at the disused industrial site at Powfoot. Indeed, this is possibly the only site in Scotland to support all Scottish native reptiles and amphibians.

3.6 Flowering Plants (medium importance)

Brownfields that have not been reclaimed can be rich in wildflowers, including former agricultural weeds that are now rare on farms, such as Mugwort *Artemisia vulgaris* and poppies *Papaver* spp. Metal-rich **mine spoil** supports interesting species, such as at Wanlockhead. Habitats that more closely resemble semi-natural environments also occur, such as orchid rich grassland within the Du Pont industrial compound at Cargenbridge.

Common Spotted Orchids are found at several industrial sites. Kirkconnel, June 2007. (Greg Baillie)

3.7 Birds (low importance)

Species that feed on weed seeds, such as Linnets *Carduelis cannabina* and Goldfinches *C. carduelis* are frequently found in large numbers on **brownfield** sites that have not been restored to a uniform land use.

4. Environmental, Economic & Social Importance of Biodiversity

- High biodiversity on working industrial sites increases adds interest and can even improve the health, job satisfaction, and therefore productivity, of the workforce.
- The biodiversity of post-industrial sites often reflects a long history of management. It should be viewed as an integral part of their industrial archaeology.

5. Factors affecting the Habitat

- Sites of high biodiversity interest on post-industrial land are at risk of destruction and serious degradation. Major factors threatening it include redevelopment, unsuitable reclamation, eutrophication, lack of appropriate management and natural succession.
- The biodiversity of post-industrial sites is easily over-looked as they are rarely visited and species may persist in low numbers.
- Few previously developed sites have been afforded SSSI protection and creation of new sites is limited.

6. Strategic Actions

6.1 Recent and current activity

- **Dumfries & Galloway Council** is required to assess significant harm to ecological systems, especially on designated sites, as part of its identification of contaminated land.
- The **Museum of Lead Mining** at Wanlockhead has produced interpretation of the wildlife of the area.
- **Magnox North** has carried out an assessment of the biodiversity interest around Chapelcross and published a Biodiversity Action Plan in 2008.
- The **Wildlife Trust's** Biodiversity Benchmark award enables businesses to assess the quality of their land management, improve their contribution to the environment and demonstrate their commitment to biodiversity.

6.2 Other recommended actions

- Encourage businesses to carry out **ecological audits** of large industrial sites and modify activities to reduce their impact.
- Encourage businesses to carry out **practical biodiversity projects** on industrial sites.
- Promote the use of **vacant and derelict land**, either temporarily or permanently as wildlife habitats.

Former brickworks at Gatehouse of Fleet, now a nature reserve. October 2004. (Peter Norman).

QUARRIES & MINERAL WORKINGS

Priority Action (QU1)

Ensure that any new restoration plans for quarries and mineral workings contribute to LBAP habitat expansion objectives.
Lead Partner: Dumfries & Galloway Council.

1. Habitat Description

1.1 Physical Characteristics

Quarries and mineral workings are common features in most landscapes. **Disused quarries** that were abandoned many years ago tend to be small-scale features that have been colonised by natural vegetation to such an extent that their previous use is not always immediately obvious. More recently abandoned quarries and **working quarries** tend to be larger and more prominent in the landscape. Perhaps the biggest single influence on their value for biodiversity is the nature of the material being worked. This not only affects the chemical composition of the soil, but the type of extraction technique employed and the landform changes that result from it. For example **hard rock quarries** tend to have high vertical rock faces, whilst **open-cast coal workings** and **sand and gravel pits** usually have a greater range of contours but cover a wider area.

Kirkmabreck Quarry at Creetown includes some of the highest rock faces in the region. July 2004. (Peter Norman)

Open water is a feature of many disused and working quarries. However, as this is usually a result of the flooding of former workings, most open waters in quarries are deep and steep-sided, with limited marginal vegetation, which limits their biodiversity value.

Dyke Farm Quarry near Moffat, formerly a sand & gravel works, now a nature reserve. October 2007. (Peter Norman).

Bare ground or bare rock is a feature of most quarries, even those long since disused. This supports a specialised for flora and fauna, though once again the physical and chemical composition of the material is critical. Quarry faces can mimic natural rock outcrops with ledges and wet seepages, but even relatively smooth surfaces can be colonised by lichens. Even where material has been excavated, but not removed from the site, it can be of biodiversity value. **Piles of large stones** with plentiful nooks and crannies can be particularly valuable.

Grasslands in quarries and mineral workings tends to be agriculturally unimproved and this, together with the shallowness of soil, often leads to a high species richness.

Scrub and woodland often colonises disused quarries and mineral workings and may be present around active ones. Willows, birches and oaks are the commonest species on the thin soils, but a wide range of woodland types is possible depending on local conditions.

1.2 National and International Context

In 2005, over 64,000 ha of land in England was under planning permission for the active working of minerals. Equivalent figures for Scotland and Dumfries & Galloway are not known.

2. Dumfries & Galloway Status

2.1 Recent Trends

Although a finite resource, demand for minerals is ongoing and every year nearly four tonnes of aggregates are needed per head of the population in the UK. The use of recycled aggregate is increasing, but there is still considerable demand for primary aggregate. The main markets now for hard stone quarrying are for aggregates and concrete products resulting in the distinctive landmarks of quarry plants such as those at Locharbriggs, Dalbeattie and Kirkcudbright. Gravel and coal extraction also contributes to the region's economy.

2.2 Current Distribution

There are at least 14 active quarries or mineral workings and many disused ones in the region. Active quarries tend to be in lower river valleys or on the coast, but disused quarries are widespread in both the uplands and lowlands. The great majority of quarrying is for hard rock, with a few open cast coal workings in Upper Nithsdale, and sand and gravel workings in Lower Nithsdale, Annandale and Wigtownshire.

2.3 Site Examples

Two disused quarries have been designated as Sites of Special Scientific Interest for their geological importance; **Clatteringshaws Dam Quarry** and **Talnotry Mine**. The biodiversity potential of quarries has so far been little explored, but live CCTV images of nesting Peregrines in **Creetown Quarry** are transmitted to Creetown Heritage Centre and **Kelhead Quarry** is a designated Local Wildlife Site. **Dyke Farm Quarry** at Moffat has recently been restored for amenity and nature conservation use.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with quarries, and the following action plans may also contain relevant information: Calcareous Grasslands, Inland Rock Outcrops, Scrub Woods, Industrial and Post-industrial Sites.

3. Importance for Associated Species

3.1 Flowering Plants (high importance)

Studies on the colonisation of plants in disused limestone quarries found that species diversity approached that found in much older semi-natural calcareous grassland within only 10-20 years.

Common Centaury *Centaurium erythraea* thrives on the well-drained, disturbed bare ground of quarries and Common Cudweed *Filago vulgaris*, which has undergone a dramatic national decline as a result of agricultural change, is known from similar habitats in at least one disused quarry. Orchids, including Common Spotted *Dactylorhiza maculata* and Common Twayblade *Listera ovata* can be abundant, depending on local conditions.

3.2 Invertebrates (high importance)

Bare ground (especially composed of soft material such as sand) combined with species-rich **grassland** makes an ideal combination for many invertebrates, particularly butterflies, bees and wasps. Quarry faces, scrub or woodland provides an additional benefit in the form of shelter from wind. A ground spider *Zelotes apricorum*, virtually restricted in Scotland to stony areas of the Solway coast, is regularly recorded from quarries in England.

Large Skipper butterfly. Clatteringshaws disused quarry, July 2007. (Peter Norman)

3.3 Birds (high importance)

Several pairs of Kestrels *Falco tinnunculus*, Peregrines *Falco peregrinus* and Ravens *Corvus corax* nest on **quarry faces** of both working and disused quarries. At Portpatrick, the extensive cliff faces quarried for the harbour works in the late 18th and early 19th centuries have been colonised by Fulmars *Fulmarus glacialis.*

Gravel works provide nest sites for Oystercatchers *Haematopus ostralegus*, Ringed Plovers *Charadrius hiaticula* and occasionally Little Ringed Plovers *Charadrius dubius*, the latter a very rare breeding species in Scotland.

Extensive areas of **grassland** may be used by Skylarks *Alauda arvensis*, whilst a wide range of birds frequent areas of scrub and woodland. **Open water** in the region's quarries is not of major importance for its bird life.

3.4 Non-flowering Plants (medium importance)

Quarries, even active ones, can support an interesting and varied bryophyte flora, though usually just a version of the natural communities found on nearby rock outcrops, rather than a specialised flora. Thick-set Earwort *Scapania compacta*, a common liverwort in rocky situations in western Britain, often grows in disused quarries.

Wet ground on disused quarry floors is good for mosses and liverworts in the few years immediately following closure, until flowering herbs and eventually scrub and trees become dominant.

3.5 Reptiles and Amphibians (medium importance)

Sir William Jardine's collection of fossil reptile

footprints found in the 1850s at the sandstone quarry at Corncockle is now in Royal Museum of Scotland in Edinburgh. More recently, the combination of **bare ground** for basking, **grassland** for hunting and **piles of stones** for hibernation makes many quarries and mineral workings good habitats for Common Lizards *Zootoca vivipara*, Slow Worms *Anguis fragilis* and Adders *Vipera berus*. Quarries are therefore valuable reptile habitats, and may be critical for their survival in areas of otherwise intensive agriculture or forestry. This habitat combination can also be good for frogs, toads and newts, but these species also require relatively shallow, well-vegetated, predominantly fishless areas of **open water**, which are often lacking from hard rock quarries, being common only in some sand and gravel workings.

3.6 Mammals (low importance)

Roosting bats use crevices and caves in **quarry faces**, and the presence of open water, grassland, woodland and scrub is also of benefit to them. However, few bat surveys of quarries have been completed in Dumfries & Galloway. Other mammals tend to be widespread and common species, for which quarries are of minor importance in relation to other habitats.

3.7 Fungi and Lichens (low importance)

Bare rock on **quarry faces** and other places is readily colonised by lichens, though few notable species are known. Other fungi associated with quarries and mineral workings tend to be generalist species, though some old quarry floors in other parts of Britain are developing good waxcap mycotas.

3.8 Fishes (low importance)

Though a number of disused quarries and mineral workings have been restored as recreational and commercial fisheries, species are generally of low conservation value.

4. Environmental, Economic & Social Importance of Biodiversity

- Features of geological interest are often exposed in quarries and mineral workings and offer opportunities for education and interpretation.
- Quarries and mineral workings restored for wildlife have the potential to be managed as nature reserves, offering recreational and educational facilities, along with associated landscape and economic regeneration benefits.

5. Factors affecting the Habitat

- **Restoration to agricultural land** has been the main after use of mineral workings, and most active sites have restoration to agriculture built into their planning consent.
- An RSPB study identified the main reasons for not restoring quarries and mineral workings to a nature conservation after-use as being a **lack of support from the landowner, a perceived inadequate financial return, a difficulty in securing long-term conservation management** and the proximity of the site to an airfield (threat of bird strike). The last reason is not relevant to Dumfries & Galloway, but all the others probably apply. The willingness of the mineral company is usually not a problem.
- **Rock climbing** can disturb nesting birds or damage flora in some quarries.
- Disused quarries and mineral workings are prone to **waste dumping**, usually unofficially and illegally. In particular, small disused quarries are a frequent location for farm dumps, though the impact on amenity value is usually greater than that on biodiversity.

6. Strategic Actions

6.1 Recent and current activity

- Dyke Farm Quarry, near Moffat, has been restored to a nature reserve following sand and gravel extraction by **Patersons of Greenoakhill Limited.**
- **Tarmac** has prepared Biodiversity Action Plans for all its quarries in Dumfries & Galloway.
- The **Mountaineering Council of Scotland** has produced an information sheet about birds and climbing, which contains guidance on responsible climbing.

6.2 Other recommended actions

Create new habitats on disused quarries and mineral workings. There is enormous potential to create a range of habitats. In England, RSPB has calculated that restoration of mineral sites for biodiversity could, in itself, meet all of the targets for at least seven UK BAP priority habitats.

URBAN WATERCOURSES & WETLANDS

Priority Action (UWW1)

Incorporate biodiversity into Sustainable Urban Drainage Systems in new developments.
Target: 10 SUDS schemes for new developments to include design enhancements for biodiversity by 2015.
Lead Partner: Dumfries & Galloway Council.

Brieryhill sustainable urban drainage scheme. Lockerbie, July 2006. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Urban rivers are often the focal point of settlements. Houses that overlook them are much in demand, and sometimes their name is even incorporated into the name of the town. Nevertheless, most are highly modified from their natural form - usually straightened with pools, riffles and gravel beds removed, hemmed in by walls and embankments and cut off from their natural floodplain (upon which the settlement is often built). In contrast, smaller **urban burns and ditches** are frequently hidden from view. They are also usually straightened and often culverted, or at least lined with concrete or steel. Although they are now much less polluted than they once were, many still receive oil and other pollutants that runs-off surrounding hard surfaces, and high nutrients levels from adjacent grass cutting and other urban activities. From an aesthetic perspective, urban watercourses are often marred by refuse and litter.

A number of other wetlands can be found in urban areas. **Ponds** were created for a range of purposes including curling ponds, distillery ponds, and mill ponds. Where this use has been lost, these ponds are often neglected. Ponds in gardens, public open spaces and industrial & post-industrial sites have separate action plans.

Sustainable Urban Drainage Systems (SUDS) are a relatively new kind of urban wetland. They are deliberately designed and constructed as an alternative to conventional urban drainage systems to reduce pollution and flood risk. They include detention basins, retention ponds, constructed wetlands, infiltration devices, swales and permeable surfaces. Some of these can be designed to improve biodiversity.

1.2 National and International Context

Many rivers and wetlands in highly industrial parts of Britain and Europe, such as the Rhine, Mersey and Tyne were highly polluted and became virtually lifeless in the mid-late 20th century. They are still recovering. None of Dumfries & Galloway's urban watercourses compare with the scale or extent of the problems in these areas.

2. Dumfries & Galloway Status

2.1 Recent Trends

There is now a better understanding of the complexity and importance of urban watercourses, and several recently installed schemes have aimed to work with nature, rather than against it. Soft engineering schemes protect banks with natural materials and avoid piped outlets. The introduction of SUDS deals with potential contaminants at source, rather than passing them downstream as quickly as possible, contributing to flood risk. These new techniques can also be used to create habitats and enhance biodiversity.

2.2 Current Distribution

There are urban watercourses and wetlands in all of Dumfries & Galloway's towns and villages.

2.3 Site Examples

A number of Dumfries & Galloway's main rivers flow through urban areas, notably the River Annan in **Annan**, Nith in **Dumfries**, Fleet in **Gatehouse**, Cree in **Newton Stewart**.

2.4 Associated Habitats

A number of habitats occur in close association and/or overlap with urban watercourses and wetlands, and the following action plans may also contain relevant information: Lowland Burns and Ditches, Public Open Spaces, Walls and Buildings, Industrial and Post-industrial Sites, Bridges and Tunnels.

3. Importance for Associated Species

3.1 Fishes (very high importance)

All fish of rural rivers, including Salmon *Salmo salar* and Trout *Salmo trutta* are also found in urban watercourses, including small burns, unless local factors have affected their habitat or food supply. The only spawning bed in Dumfries & Galloway of the nationally rare Sparling *Osmerus eperlanus* is located within Newton Stewart. The fact that towns and villages are often located on the lower reaches of rivers means that any problems here may limit the free movement of migratory fish throughout the catchment.

3.2 Reptiles and Amphibians (high importance)

Urban ponds wetlands, rather than flowing watercourses, support high populations of most native amphibians, particularly Common Toads *Bufo bufo,* Common Frogs *Rana temporaria* and Palmate Newts *Lissotriton Helvetica*. A few ponds, such as those at Gatehouse of Fleet and Newton Stewart, also have Great Crested Newts *Triturus cristatus.*

3.3 Mammals (high importance)

Although domestic cats undoubtedly take some Water Voles *Arvicola terrestris*, it has been suggested that they are less susceptible to predation on urban watercourses, due to the deterrent effect of cats on Mink. Otters *Lutra lutra* make frequent, often nightly, use of all urban rivers and on occasion even quite small burns.

Bats, which find many roosting opportunities in urban buildings and bridges, use watercourses for feeding. Pipistrelles *Pipistrellus sp.,* Noctules *Nyctalus noctula* and Daubenton's *Myotis daubentonii* bats are regularly recorded on the River Nith in Dumfries town centre.

3.4 Non-flowering Plants (high importance)

Polluted urban watercourses are associated with masses of Blanket-weed *Cladophora* on the surface or bottom, but such a sight is now rare. Instead, freshwater algae form the basis of aquatic foodchains and are essential for a healthy watercourse.

3.5 Birds (medium importance)

Mute Swans *Cygnus olor*, Mallards *Anser platyrhynchos,* Moorhens *Gallinula chloropus*, Kingfishers *Alcedo atthis* and Grey Wagtails *Motacilla cinerea* are residents or frequent visitors to many urban watercourses and wetlands. Dippers *Cinclus cinclus*, although usually associated with river headwaters, are also associated with some urban rivers, nesting annually in the centre of Dalbeattie and Gatehouse of Fleet.

Mallard, the typical duck of urban watercourses. (Peter Norman)

3.6 Invertebrates (medium importance)

Some species such of invertebrates, such as the larvae of *Chironomus* midges and *Tubifex* worms will survive in even highly polluted watercourses but in cleaner water mayfly and stonefly nymphs may be found. Indeed the species composition of watercourses is an accurate measure of pollution levels, and these species provide the food supply of many fish and birds. Variable Damselfly *Coenagrion pulchellum* has a restricted UK distribution but has been found on a number of ponds in Dumfries & Galloway, including some close to urban locations.

Mute Swans and Cygnets, Paul McLaughlin

3.7 Flowering Plants (medium importance)

The banks of urban watercourses and wetlands have been highly managed for many years, usually giving

rise to a plant community dominated by opportunist invaders such as Monkey Flowers *Mimulus* spp. and Himalayan Balsam *Impatiens glandulifera.* Both were introduced as garden flowers in the 19th century, but spread rapidly along watercourses during the late 20th century. Complete eradication of them is now impossible. Instead they should be appreciated for the urban colour, bank stabilisation and nectar sources they provide. A few less common species have been recorded, including Yellow Bartsia *Parentucellia viscosa* on the banks of the Nith in Dumfries.

4. Environmental, Economic & Social Importance of Biodiversity

- More natural management of urban watercourses and wetlands reduces flood risks.
- Unpolluted and biodiverse watercourses and wetlands provide landscape, recreation and quality of life benefits for urban residents.
- Shallowly sloping banks with marginal vegetation are safer than canalised watercourses, as they limit access to deep water.

5. Factors affecting the Habitat

- There is a **perception** that all watercourses in urban areas are a safety hazard and an inconvenience. As a result they have often been hidden from public view with little or no access. This is especially the case with smaller burns.
- **Previous management** has focussed on increasing flow capacity. This has resulted in embanking, straightening, mechanical excavating, lining with concrete or steel, and culverting of watercourses in urban areas.
- **Management of urban infrastructure**, such as bridges, footpaths and street lighting can affect some species.

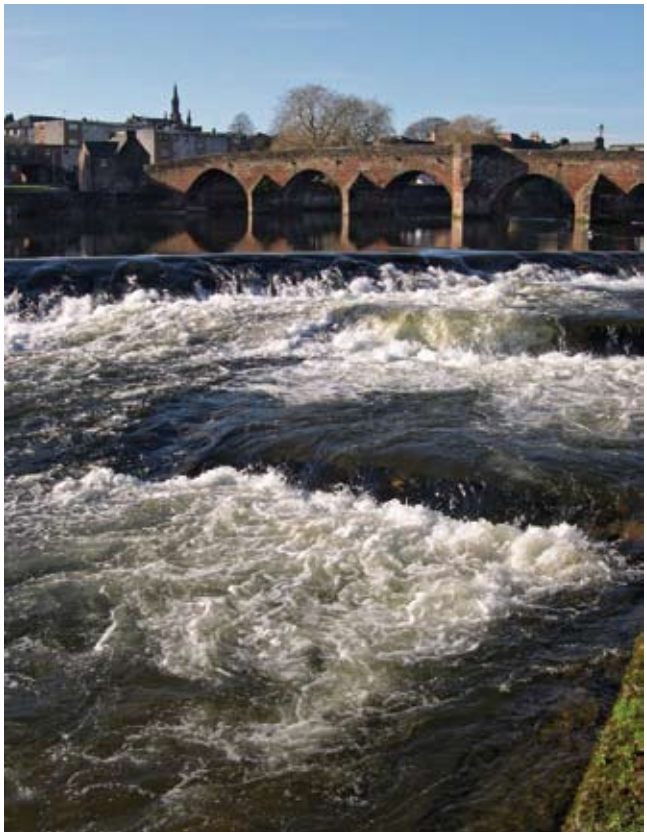
6. Strategic Actions

6.1 Recent and current activity

- **Dumfries & Galloway Council** has published Supplementary Planning Guidance on the Flooding and the use of Sustainable Urban Drainage Schemes. Several SUDS have been installed in urban developments and under the Controlled Activities Regulations they are now required for all new development except for surface water discharging into coastal waters and for single dwellings. In certain locations it is possible to design such schemes to enhance biodiversity.

6.2 Other recommended actions

- **Protect all existing stretches of semi-natural river and burn** corridor and other wetlands in urban areas.
- Encourage designers and developers to use **alternatives to culverts** on rivers and burns through urban and other areas.
- Where feasible and realistic, **restore degraded sections of watercourse**, particularly weirs, underground and concrete-lined sections. Provide variation in stream and bank habitats, such as riffles, pools, gravel beds and vegetation.
- **Enhance SUDS** to provide biodiversity benefits, as well as preventing pollution from surface water drains entering watercourses and reducing peak flows.



The River Nith in Dumfries town centre supports a wide range of species. February 2008. (Peter Norman)

RESERVOIRS

Priority Action (RE1)

Increase the availability of biodiversity information relating to reservoirs, in order that it can be used in maintenance and management programmes.
Target: Collect and collate all biodiversity information relating to reservoirs by 2015.
Lead Partner: Dumfries & Galloway Environmental Resources Centre.

Grassland at Glenkiln Reservoir, dominated by Pignut. June 2007. (Peter Norman)

1. Habitat Description

1.1 Physical Characteristics

Water supply and water power are the two main reasons for the reservoir construction. Reservoirs for both purposes are designed to catch and maintain water from watercourses and catchments, and release it under controlled conditions. The largest reservoirs are usually in upland areas where dams have flooded extensive valleys, sometimes expanding natural lochs, but sizeable lowland reservoirs also exist. Some have been made by damming shallow valleys, others are sited on fairly flat land with earth banks lined with concrete used to retain the water. Lowland reservoirs tend to have greater biodiversity than upland ones, usually because the latter are sited over more acidic geology, the water is deep, and the banks are steep-sided.

The **draw-down zone** is a feature common to most reservoirs, but rare in natural waterbodies. As water is pumped in and out, areas of bare mud and rock may be regularly flooded and exposed. Depending on the use of the reservoir, cycles of exposure can vary from days to months, creating harsh ecological conditions that can support only specialised plants and animals.

Dams take a variety of forms, from simple earth banks to major stone or concrete walls.
It is a legal requirement to install effective **fish passes** on all new dams, but older dams may have only rudimentary passes.

1.2 National and International Context

Reservoirs are widespread throughout Britain. There are at least 14 reservoirs in Dumfries & Galloway currently used for hydro-power or water supply, in addition to a number of small or disused reservoirs.

2. Dumfries & Galloway Status

2.1 Current Distribution

Most reservoirs in Dumfries & Galloway tend to be modified natural lochs. The greatest concentration is the series that powers the hydro-electric stations of the Dee-Ken valley. Elsewhere, they are well scattered across the region, mainly in the upland fringe.

2.2 Site Examples

Clatteringshaws Loch, with its large dam, may appear to be the region's largest reservoir but it feeds,

via a pipeline, into the Dee-Ken system where the long, narrow **Loch Ken** (SPA/SSSI) covers a larger area. This reservoir lacks a major dam, appears very natural and has high biodiversity. Other sizeable reservoirs include **Penwhirn, Loch Whinyeon, Lochinvar, Glenkiln, Black Esk** and **Winterhope**, as well as several smaller dams on other waterbodies. **Blates Mill Dam** (LWS), near Laurieston, now shows little of its artificial origins, the small dam being barely discernible amongst natural vegetation.

2.3 Associated Habitats

A number of habitats occur in close association and/or overlap with reservoirs, and the following action plans may also contain relevant information: Eutrophic Lochs, Mesotrophic Lochs, Oligotrophic Lochs, Swamps, Industrial and Post-industrial Sites.

3. Importance for Associated Species

3.1 Fishes (very high importance)

The most significant impact of reservoirs on fish populations is caused by dams that lack properly functioning fish-passes. These prevent free movement of all species of fish up and down the watercourse, but migratory species such as Salmon *Salmo salar* and Sea Trout *Salmo trutta* can be especially affected. There are no Eels *Anguilla anguilla* upstream of Tongland Dam, due to the difficulty of adults passing downstream though the power station.

In the reservoirs themselves, there are few resident species of conservation importance. Typical species include Pike *Esox lucius* and Perch *Perca fluviatilis*.

3.2 Non-flowering Plants (high importance)

The exposed **draw-down zone** of reservoirs is an important habitat for several species of mosses and liverworts. Many are tiny and ephemeral, but grow in profusion when conditions are right. The wet mud nearest the water's edge is likely to produce the rarest species. Species of this habitat include Clay Earth Moss *Archidium alternifolium*, Delicate Earth Moss *Pseudephemerum nitidum* and Drummond's Thread Moss *Pohlia drummondii*. Although only the latter species has been recorded from a reservoir in Dumfries & Galloway (Clatteringshaws) this probably reflects a lack of survey work.

Dumfries & Galloway's best known plant of reservoirs is a grass-like fern Pillwort *Pilularia globulifera,* with the reservoirs of the Dee-Ken hydro scheme providing one of its UK strongholds. Though largely submerged, it benefits from fluctuating water levels.

3.3 Birds (medium importance)

Loch Ken is the outstanding reservoir in the region for bird life, with a wide range of wildfowl and waders. Unlike some other parts of Britain, Dumfries and Galloway has few other large reservoirs that attract large numbers of waterfowl, only small numbers of Great Crested Grebes *Podiceps cristatus* and common species of duck, sometimes with night-time roosting of geese and Whooper Swans *Cygnus cygnus.*

Common Sandpipers *Actitis hypoleucos* often feed and nest in the **draw-down zone**. Ringed Plovers *Charadrius hiaticula* have also known to frequent the draw-down zone and previously nested at Clatteringshaws, but inland breeding is now rare.

A number of species, including Kestrels *Falco tinnunculus*, have been known to nest on **dams**, usually in cavities or on associated infrastructure.

3.4 Flowering Plants (medium importance)

Typical plants of the **draw-down zone** include Shoreweed *Littorella uniflora,* Amphibious Bistort *Persicaria amphibia,* Marsh Yellow-cress *Rorippa palustris* and Marsh Cudweed *Gnaphalium uliginosum.* The locally scarce Trifid Bur-marigold *Bidens tripartita* is found at Loch Ken.

3.5 Mammals (medium importance)

The mammal fauna of Dumfries & Galloway's reservoirs differs from their more natural freshwater counterparts. Otters *Lutra lutra* are present on all such waterbodies.

3.6 Invertebrates (low importance)

Though rare beetles, spiders and other invertebrates are found on Loch Ken, they are not typical of reservoirs in the region, which generally have a restricted range of common aquatic invertebrates.

3.7 Reptiles and Amphibians (low importance)

Most large reservoirs are too deep and have too many fish to support amphibian populations, though common species occur at a few locations.

4. Environmental, Economic & Social Importance of Biodiversity

Blue-tailed Damselflies breed in a wide range of waterbodies, including well-vegetated reservoir margins. (Gavin Chambers)

- Reservoirs can attract tourists and other visitors to watch wildlife. Several of the most popular nature reserves in Britain are based around reservoirs.
- Well-managed fisheries can produce income and enhance biodiversity.

5. Factors affecting the Habitat

- **Poorly designed dams and fish passes** restrict or prevent fish movement. Other problems may result from altered flow velocities and changes to water temperatures and oxygen levels in reservoirs, and in the release of stored water from reservoirs.
- Some deliberately **introduced species**, including non-native fish introduced for angling, pose a threat to other species. North American Signal Crayfish are present in Loch Ken and could spread to adjacent catchments.
- **Recreational activities** such as boating, walking and angling can disturb wildlife, though such disturbance is rarely significant in Dumfries & Galloway.

6. Strategic Actions

6.1 Recent and current activity

- **Scottish Power** has prepared a Biodiversity Action Plan for the Galloway Hydros Scheme. For example, work with Galloway Fisheries Trust is underway to improve fish passage.
- Recreational activities on Loch Ken are strictly zoned to minimise disturbance to wildlife, and **Scottish Power** has an agreement with RSPB to manage water levels, as far as possible, in order to benefit breeding birds.

6.2 Other recommended actions

- Assess the biodiversity of all reservoirs and, where feasible, **incorporate biodiversity** conservation and enhancement into maintenance and management programmes.

Willow scrub below Clatteringshaws Dam. July 2007. (Peter Norman)

SINGLE-CELLED SPECIES

1. Status and Distribution

In terms of weight, single-celled organisms are the most abundant form of life on this planet. They are too small to be seen by the naked eye but make up around half of all known species in Scotland:

Viruses: An estimated 3,300 species in Scotland.
Bacteria: An estimated 3,300 species in Scotland.
Protozoa: A rough estimate of more than 37,000 species in Scotland.

Viruses cannot multiply on their own, so they have to invade a 'host' cell and take over its machinery in order to be able to make more virus particles. Bacteria are capable of multiplying by themselves, as they have the power to divide. They exist everywhere, including on and inside our bodies. Viruses and bacteria are best known as agents of disease but most of them are completely harmless and some of them are essential for life.
The principal importance of Protozoa is to control the numbers and biomass of bacteria. They are also important as parasites and symbionts (where both partners benefit from the relationship) of multicellular animals.

A slime mould Lycogala sp. on decaying wood. (Peter Norman)

Slime moulds share some of the characteristics of protozoa single-celled organisms. However, they have been traditionally studied by mycologists and are often included in fungal studies. Physiologically, the creeping movement achieved by slime moulds is definitely animal-like, but the spore producing reproductive structures are fungus-like. They can be found in a variety of habitats, particularly on rotting wood or seaweed, but almost nothing is known about their distribution and importance in Dumfries & Galloway.

There is still much to discover about single-celled organisms, but it becoming clear that this microscopic life keeps many ecosystems functioning and keeps the Earth habitable. They play a particularly important role in soil ecosystems, though precisely how is not yet clear. It is likely that they are critical to many processes, including decomposition, nitrogen transformations, hydrological cycling and energy balances. Micro-organisms keep soils fertile, and detoxify pesticides and other pollutants.

Viruses numerically dominate the microbial component of the oceans with concentrations often found in excess of 100 million viruses per teaspoonful of seawater. Viral action has far reaching implications in determining microbial biodiversity, nutrient and energy flow, biogas production and hence contribute to global climatic control.

2. Threats

The principal threat to single-celled organisms is ignorance of their critical role and the potential impact of human activities. Whilst it is not currently feasible to manage habitats to enhance their populations of single-celled organisms, there are certain activities that are known to be damaging to them, and should be avoided where possible. Principal amongst these is excessive disturbance and contamination of soils.

FUNGI & LICHENS

1. Status and Distribution

Shaggy Scalycap Pholiota squarrosa in Castledykes Park, Dumfries. October 2007. (Peter Norman)

Although some fungi resemble plants, molecular evidence suggests that they are more closely related to animals. However, they are sufficiently different to both to warrant their own kingdom. Most fungi grow in the form of microscopic filaments called hyphae that extend and branch at their tips to form a vast network or mycelium. The familiar mushrooms are merely the fruiting structures that arise from such a network, but many fungi do not have this shape.

Fungi can reproduce vegetatively, but to exploit new habitats they produce millions of spores. Very few of these will successfully form new colonies. The larger fungi are divided into two main groups based on the way that they produce their spores. The *Ascomycota* produce their spores inside a long cell called an ascus. The *Basidiomycota* form their spores externally on a club-like cell called a basidium.

It is not possible to say with any certainty how many species occur in a particular locality as fruiting is highly variable from year to year. They are also very easy to miss since most species produce fruit bodies that decay and disappear within a few days. There are certainly more than 3,500 larger species in Britain, and as many as 12,000 if the microfungi are included. Few surveys have been completed in Dumfries & Galloway, so the figures below are likely to be well below the actual number of species present.

Minimum estimates of number of larger fungus species in Dumfries & Galloway (excluding lichenised fungi)

Wigtownshire	650
Kirkcudbrightshire	800
Dumfriesshire	450

Fungi play a vital role in nature. Many are saprotrophs, living on dead organic matter such as leaf litter and have an important role in recycling. Others form associations with the roots of trees and other plants (mycorrhizal fungi), assisting in the uptake of water and nutrients. Over 90% of plants have a fungus associated with their roots and many would not survive without their fungal partner. There are also over 1,000 species of invertebrate in the UK that are dependent on fungi for food and shelter.

Some of the most important organisms used in biotechnology are fungi. Brewing and baking have been carried out for thousands of years and both are dependent on fungal yeasts. Fungal fermentation has been harnessed to manufacture important therapeutic compounds, such as antibiotics and the cyclosporins used for preventing rejection of human organ transplants. Many enzymes are produced from fungi for use in the food, textile and other manufacturing industries. Indoor cultivation of edible mushrooms is a major industry, but so far limited to a few species.

Lichens consist of a fungus and an alga that live in close association with each other. The alga manufactures food through photosynthesis, whilst the fungus forms the main body of the lichen and provides a stable, protective environment for its alga. They reproduce by tiny spores that are borne on special miniature ‘fruit bodies’, though some can also reproduce vegetatively. Some crust lichens grow as slowly as 0.1mm a year and can live to a great age, probably the oldest living organisms in Scotland.

Map Lichen Rhizocarpon geographicum. Whithorn, August 2007. (Peter Norman)

Being home to some 1,600 species, Scotland is a European biodiversity hotspot for lichens, resulting from its varied geology, topography and climate, comparatively rich heritage of ancient woodlands, and its possession of large areas little affected by atmospheric and water pollution, and intensive agricultural practices.

Curry-scented Milkcap Lactarius camphoratus, one of many species that exude a milky liquid from the gills. Hills Wood, September 2006. (Peter Norman)

Particularly important habitats for fungi include sand dunes, unimproved grasslands, and upland heaths; with the addition of coastal cliffs, inland rock outcrops and even man-made walls for lichens. However, woods and other habitats with trees are the best of all. Birches, willows, pines and old oaks are especially good for fungi and Ash, Hazel, Wych Elm and Sycamore for lichens, though some species, including rare and threatened ones, occur in association with other trees.

2. Threats

- Despite their vital role in ecosystems, fungi are rarely included in recording schemes, conservation projects and environmental assessments.

Candle-snuff Fungus Xylaria hypoxylon. Drumlanrig, September 2006. (Peter Norman)

- Air pollution has been a major factor in the loss of fungi and lichens in the UK, though areas such as Dumfries & Galloway have been less severely affected. Continued improvements in air quality have resulted in recovery of lichen populations.
- Loss of habitat has affected many species. For example, loss of mature elms through Dutch elm disease has drastically reduced Orange-fruited Elm Lichen *Caloplaca luteoalba* and *Bacidia incompta*, which were both formerly characteristic on the trunks of elms in rural, wayside and parkland situations. Loss of unimproved grassland and deadwood has had a similar impact on many fungi.

3. Opportunities

Devil's Matchstick lichen Cladonia sp. Ironhirst Moss, February 2007. (Peter Norman)

- Manage fungi and lichen habitats appropriately, including minimum disturbance to soils, minimising nutrient enrichment and pollution, and retaining a full range of dead wood habitats. Habitat management is the only secure, long-term way of ensuring the conservation of most species.
- Encourage mycologists and lichenologists to visit and record in Dumfries & Galloway. Approximately half of Dumfries & Galloway's rare species of fungus were recorded by visiting mycologists on only two days in September 1993 – an indication that there are likely to be more rare species waiting to be discovered by anyone with the necessary identification skills.
- Follow the Scottish Wild Mushroom Code when collecting fungi.

4. Further Information

4.1 Publications

- Fletcher, A. (ed) (2001) *Lichen Habitat Management*. British Lichen Society, London.
- Spooner, B. & Roberts, P. (2005) Fungi. HarperCollins, London. (A general introduction to fungi but also includes a chapter on conservation)

4.2 Websites

- Association of British Fungus Groups www.abfg.org
- British Mycological Society (fungi) www.britmycolsoc.org.uk
- British Lichen Society www.thebls.org.uk
- UK Fungi http://fungus.org.uk/

NON-FLOWERING PLANTS

Great Horsetail. Port Kale, August 2006. (Peter Norman)

1. Status and Distribution

Non-flowering plants consist of ferns, clubmosses, quillworts, horsetails, mosses, liverworts, hornworts and algae. Together they constitute a significant proportion of the UK's biodiversity.

There are around 2,100 species of mosses, liverworts and hornworts (collectively known as bryophytes) in the UK. This is one of the few species groups that is better represented in Scotland than in England, with almost 90% of the UK bryophyte flora found here, constituting around 60% of the European, and possibly as much as 5% of the world bryophyte flora. UK ferns and allied plants are less numerous, with 47 ferns, 7 clubmosses, 3 quillworts and 8 horsetails.

Climate is the major influence on bryophytes and ferns, and Britain's cool wet conditions are ideal for many species, though very few are limited to Britain and most can be found across the world. However, Britain, and north west Scotland in particular, is internationally famous for its 'Atlantic' bryophytes, some of which are otherwise found only in the Himalayas and British Columbia. Indeed, in international terms north west Scotland's bryophytes (and lichens) are perhaps the single most important biodiversity feature of the UK. Some of these important species have small outlying populations in other areas, especially north Wales, the Pennines, the Lake District and Dumfries & Galloway.

Bryophytes and ferns are perfectly adapted for rapid dispersal by vast numbers of tiny wind-borne spores, quickly colonising all natural and man-made habitats and dominating some of them. They are sensitive to air and water pollution, and many act as indicators of a clean environment. They also fulfill a variety of other environmental roles, including providing a habitat for invertebrates and fungi; nutrient recycling in wetlands, woodlands and forests; stabilising damaged or burnt ground; and reducing flash flooding through their water absorption capacity. Yet they are often an ignored and neglected part of Scotland's biodiversity, and new discoveries are still being made.

Algae are the dominant plants of the marine and freshwater habitats. The majority are invisible to the naked eye and some species are more closely related to fungi and primitive animals than to flowering plants, but the seaweeds are the botanical masters of the sea, sometimes reaching hundreds of metres in length. Together algae carry out just under half of all the photosynthesis on earth, and they fulfill essential roles through modification the atmosphere, production of most of the marine and freshwater nutrients that support fisheries, and by providing ingredients for many foodstuffs. However, some species can cause problems, such as toxic blooms in lochs and reservoirs during the summer.

Algae are the most numerous of the non-flowering plants with more than 20,000 species thought to occur in the UK, around 9,000 of them in Scotland. Diatoms, none of which is larger than 2mm in diameter, are the predominant algal group in terms of both photosynthesis and numbers of species. They occur in almost all aquatic habitats, suspended in water (planktonic), moving through sediments, or attached to rock or other surfaces. A few grow on land, on soil or damp rock faces. Other algae form associations with fungus to create lichens, whilst stoneworts are a unique group of complex algae that typically grow in fresh or brackish water that is clear and unpolluted. 30 are found in the UK.

Minimum estimates of number of non-flowering plant species in selected groups in Dumfries & Galloway

Ferns *Filicopsida*	40
Clubmosses & Quillworts *Lycopsida*	9
Horsetails *Sphenopsida*	8
Liverworts *Marchantiophyta*	170
Hornworts *Anthocerophyta*	3
Mosses *Bryophyta*	450
Red Seaweeds *Rhodophyceae*	100
Brown Seaweeds *Phaeophyceae*	56
Green Seaweeds *Chlorophyceae*	44

Particularly important habitats in Dumfries & Galloway for non-flowering plants include intertidal rocky shores, coastal sand dunes, coastal cliffs and slopes, native woods, lochs, rivers, fens, raised bogs, blanket bogs, inland rock outcrops, upland springs and flushes, and montane heaths.

2. Threats

Lack of knowledge about the distribution of non-flowering plants in Dumfries & Galloway, and the shortage of ecologists able to identify many of these species, is one of the greatest constraints on local conservation projects. However, this should not be used as an excuse for damage. Threats include:

- Changes in climate as a result of global warming may affect upland bryophyte flora.
- Air pollution is less of a threat than it once was, but still has the potential to locally affect non-flowering plant populations.
- Eutrophication resulting from the widespread use of fertilisers can be extremely damaging, especially in watercourses where common species of algae can wipe out more important non-flowering plants.
- Developments, including windfarms, hydro-electric schemes and roads, may be detrimental to habitats rich in non-flowering plants.
- Muirburn of wet ground can wipe out important bryophyte populations.
- The spread of non-native invasive species, especially *Rhododendron* in native woods poses a threat to bryophytes in these habitats. However, Dumfries & Galloway's woods are generally not as badly infested as those further north. Overgrazing and undergrazing of woods may also affect ferns and bryophytes.
- Drainage of bogs and other wetlands, as well as previous afforestation of many of these sites has reduced populations. Commercial peat extraction for horticulture is a non-sustainable use of a resource largely created from bog-mosses.
- Indiscriminate collecting of mosses for floral displays and hanging baskets is known to occur, but its effects are not clear.

3. Opportunities

- Raise awareness of the importance and sustainable uses of non-flowering plants
- Train ecologists and amateur naturalists in the identification and recording of non-flowering plants.
- Encourage non-flowering plant experts to visit and record in Dumfries & Galloway.
- Take the requirements of non-flowering plants into account in habitat management works.
- Reduce, and ultimately stop the use of horticultural peat.

4. Further Information

4.1 Publications

- Long, D. and Ward, S. (2005) *Strategy for the conservation of lower plants and fungi in Scotland*. Plantlife International, Salisbury.
- Rothero, G.P. (2005) *Mosses and Liver*worts. Scottish Natural Heritage, Battleby.

4.2 Websites

- British Bryological Society (mosses & liverworts) www.britishbryologicalsociety.org.uk
- British Pteridological Society (ferns) www.nhm.ac.uk/hosted_sites/bps/
- British Phycological Society (algae) www.brphycsoc.org

A liverwort Conocephalum conicum. Dunskey Glen, July 2003. (Maggi Kaye)

FLOWERING PLANTS

1. Status and Distribution

Flowering plants form the major part of the very visible and easily recognisable biodiversity of the UK. They consist of two major groups – conifers that have seeds in a cone (Gymnosperms); and the others, which have the seeds in a fruit (Angiosperms). Angiosperms are further divided depending on whether they have one or two seed-leaves. Those with two (Dicotyledons) form most of the flowering plants; those with one (Monocotyledons) include grasses, sedges, rushes and orchids. Together, they range from the tallest trees, through shrubs to very small flowering plants such as pearlworts and Mossy Stonecrop that are less than 1cm high.

There are around 4,100 species of flowering plants in the UK. In the context of Europe, this number is low, partly on account of the physical separation of the British Isles from continental Europe after the last Ice Age. Before this, many species were able to colonise the islands, but the rise in sea-levels to form the English Channel and the North Sea created a barrier to the colonisation of further species. It is also partly because of the smaller range of habitats than on continental Europe with, for example, no mountains to rival those of the Alps nor large expanses of forest. Climatic variations are also smaller than those on the continent and this restricts the UK flora.

Sheep's-bit, Killantringan Bay, July 1998. (Peter Norman)

Unlike non-flowering plants there is a general decrease in the number of species the further north one goes in the UK. This is partly a reflection of climatic differences between the various parts of the UK, but also a reflection of the less diverse geology of Scotland compared to that of southern England. However the west of Scotland, although on the same latitude as southern Norway, Moscow, Hudson Bay, and the Aleutian Islands, is influenced by the North Atlantic Drift or the Gulf Stream that renders the climate more temperate than these places. Consequently there is an overlap of plants in Scotland between northern species of mainly of Arctic, boreal or montane climates, and southern species of temperate, southern temperate, Atlantic and Mediterranean climates.

Of the plant species occurring in the wild in the UK, Dumfries & Galloway has under half, with the distribution between the three constituent counties as shown in the table below.

Number of species recorded in the three vice-counties of Dumfries & Galloway

	Dfs.	Kbt.	Wig.
All records	1288	1488	1209
Modern records (since 1970)	1134	1363	1084
Native	825	925	777
Archaeophytes	63	66	65
Neophytes	181	297	181
Casuals	62	72	58

Archaeophytes are species introduced by man up to 1500 AD; neophytes are species introduced by man since 1500; casuals are species intermittently recorded and with no established populations.

Native species make up around 70% of our wild flora, the remaining 30% being introduced to the region, either accidentally or deliberately by man. The proportion of the latter group is likely to increase with human activities.

Yellow Flag Iris, Brighouse Bay. June 2004. (Peter Norman)

The most important habitats in Dumfries & Galloway for flowering plants are those where nutrient enrichment by man's activities has not been high. These include much of the uplands, the coastline, native woods, raised and blanket bogs, some lowland and upland lochs, unimproved grassland and fens and marshes. Flowering plants of aquatic habitats have traditionally been overlooked by botanists and are under recorded. They have specific habitat requirements, governed by water flow, alkalinity, nutrient levels, substrate and water depth.

2. Threats

There is a considerable database on the distribution of flowering plants since 1962 which is being added to continuously. However there is little data on population size, which makes it difficult to assess changes in the flora. Threats include:

- Climate change, or global warming, which will affect not only the species present in the region, but also the composition of the flora of all habitats. Upland and montane species are most at risk.

Harebell, Ravenshall. July 2007. (Peter Norman)

- Rising sea levels could affect the shoreline plant communities and a loss of habitat coupled with an inability of the plants to transfer to new areas quickly enough.
- Eutrophication particularly of water-courses and water bodies as a result of widespread use of nitrate and phosphate based fertilisers draining in to the waters. The most vigorous species may out-grow and suppress the slower growing and rarer species that often rely on nutrient-poor soils for survival.
- Developments such as wind-farms, hydro-electric schemes and roads may be detrimental to habitats by alteration of drainage patterns, partial destruction of habitats, and fragmentation of habitats.
- Muirburn can reduce the heather component of heathlands to be replaced by coarse purple moor-grass with a lower species diversity
- Spread of invasive, non-native species such as Rhododendron *Rhododendron ponticum,* Japanese Knotweed *Fallopia japonica,* Variagated Yellow Archangel *Lamiastrum galeobdolon,* New Zealand Pigmyweed *Crassula helmsii,* and other aquatic species. This can result from dumping of unwanted garden plants in the countryside, where a few species may become invasive.
- Overgrazing or under-grazing of marginal habitats such as native woods, bogs, heaths and unimproved grasslands.
- Drainage of upland habitats and wetlands and replacement with a monoculture crop, for forestry and agricultural purposes, thereby reducing diversity.
- 'Gardening' of the countryside by repeated mowing/cutting of road verges which reduces biodiversity and the planting of roadsides with inappropriate species such as cultivated daffodils, introduced willows, seed mixtures derived from non-local sources (often introducing species not found in the region).

3. Opportunities

- Raise awareness of the importance and sustainable uses of flowering plants.
- Increase the recording of flowering plants in the region by training people in identification and recording methods, utilising the Dumfries & Galloway Environmental Records Centre.
- Amend the management of road verges to recognise their important contribution to plant diversity and the attractiveness of the area
- Encourage participation in the government-funded agri-environment schemes.
- Encourage schools to become involved with projects to enhance the school grounds and to become more aware of their environment through visits to nature reserves.
- Encourage developers, land managers and planners to recognise the importance of biodiversity and develop a unified approach to the natural environment.

Bog Asphodel, Cree Valley. July 2007 (Peter Norman)

4. Further Information

4.1 Publications

- Martin, M. E. R. (1985) Wild Plants of Dumfriesshire. Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society III, 60, pp21-42.
- Silverside, A. J. (1990) *The Flowering Plants and Ferns of Wigtownshire: A very provisional check-list*. Unpublished.
- Stewart, O. M. (1990) Flowering Plants and Ferns of Kirkcudbrightshire. *Transactions of the Dumfriesshire and Galloway Natural History and Antiquarian Society III, 65, pp1-68.*

4.2 Websites

- Botanical Society of the British Isles www.bsbi.org.uk
- Plantlife www.plantlife.org.uk

INVERTEBRATES

1. Status and Distribution

Excluding microscopic species, at least 30,000 terrestrial and freshwater species of invertebrates are known in Britain, greatly outnumbering the combined total for plants, fish, amphibians, reptiles, birds and mammals. More than 14,000 species of insect alone have been recorded in Scotland. There are 60-70% fewer species in the marine environment, but the diversity of invertebrate lifeforms here is much greater with over 200 Orders, as opposed to less than 40 Orders on land and freshwater.

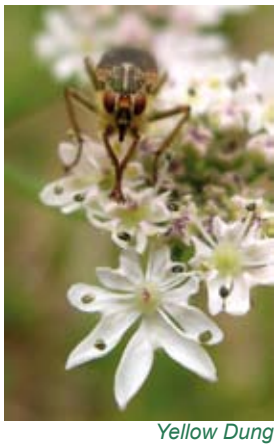
The number of invertebrate species occurring in Dumfries & Galloway will always remain unknown, although reasonably accurate estimates are available for some of the better studied groups.

Minimum estimates of number of invertebrate species in selected groups in Dumfries & Galloway

Land & freshwater snails & slugs *Mollusca*	121
Marine shellfish *Mollusca*	70
Dragonflies *Odonata*	21
Grasshoppers & Crickets *Orthoptera*	9
Mayflies *Ephemeroptera*	16
Lacewings *Neuroptera*	13
Butterflies & Larger Moths *Macrolepidoptera*	570
Ground Beetles *Carabidae*	139
Hoverflies *Syrphidae*	132
Spiders *Araneae*	280
Millipedes *Diplopoda*	26

Velvet Swimming Crab - almost all crustaceans are marine or aquatic species. (Paul Naylor)

Given that many terrestrial invertebrate species favour warm and relatively sunny conditions, Dumfries & Galloway's geographical position with a long south-facing coast and mild winters makes it more suitable for many species than other parts of Scotland.



Yellow Dung Fly Scathopaga sp.Kirkcudbright, July 2005. (Peter Norman)

Invertebrates occur in every habitat and every location in Dumfries & Galloway. Of particular importance are:

- Intertidal sand, mud and rock for molluscs and many other marine invertebrates.
- Bare ground and dunes for mining bees and solitary wasps
- Wetlands for dragonflies, mayflies, aquatic bugs, water beetles, ground beetles and craneflies
- Flower rich grassland and scrub for weevils, leaf beetles, bumblebees and hoverflies
- River shingle for beetles and flies. Together with riverbanks, this habitat supports over 10,000 species.
- Coastal strandlines for sandhoppers, beetles and snails.
- Coastal slopes for grasshoppers & crickets, butterflies & moths and beetles.

Green Hairstreak butterflies are most common in the region on raised bogs. Catherinefield Moss, May 2007. (Peter Norman)

- Decaying wood for longhorn beetles, rove beetles and flies, including hoverflies and fungus gnats. Over 1,000 species are found no-where else.
- Wet woodland for craneflies, moths and flies, including hoverflies.

2. Threats

In the past there has been a widespread but erroneous belief that management for plants or vertebrates on a site will automatically cater for invertebrates. It is now clear that the needs of many invertebrates are not being met, even on nature reserves and many of Britain's historically important

invertebrate sites have declined due to a prolonged sequence of inappropriate habitat management decisions.

Not all invertebrates have the same needs and a simple uniform approach to habitat management may not maintain biodiversity, but there are a number of basic principles of invertebrate conservation:

Speckled Bush Cricket. Ravenshall, August 2007 (Pete Robinson)

- Many invertebrates have very specialised habitat requirements. Apparently minor features and microclimates may be of vital importance to them.
- Most invertebrates have annual life cycles. Suitable conditions must be present in each and every year. It may only take one 'wrong' year to cause local extinction. Poor timing of habitat management may have profound effects.
- Many species have poor powers of dispersal and cannot easily colonise new sites.
- Life cycles can be complex with different stages requiring different habitats.
- Vegetation structure is important, as is the juxtaposition of habitats, including edges and transitions in vegetation.

Nursery-web Spider Pisaura mirabilis. Dalbeattie Forest, May 2006. (Peter Norman)

3. Opportunities

- Take the requirements of invertebrates into account in habitat management works.
- Manage sites to create a mosaic of habitats and a varied vegetation structure.
- Raise awareness of the importance and sustainable uses of invertebrates.
- Train ecologists and amateur naturalists in the identification and recording of invertebrates.
- Encourage entomologists to visit and record in Dumfries & Galloway.

4. Further Information

4.1 Publications

- Kirby, P (1992) *Habitat Management for Invertebrates: A Practical Handbook*. RSPB, Sandy.
- Buglife (2005) *Managing Priority Habitats for Invertebrates*. Buglife.
- Futter et al. (2006) *Butterflies of SW Scotland*. Argyll Publishing, Glendaruel.

4.2 Websites

- Amateur Entomologists Society www.amentsoc.org
- Bees, Wasps & Ants Recording Society www.bwars.com
- British Arachnological Society (spiders & allies) www.britishspiders.org.uk
- British Conchological Society (molluscs) www.conchsoc.org
- British Dragonfly Society www.dragonflysoc.org.uk
- British Entomological and Natural History Society www.benhs.org.uk
- British Myriapod and Isopod Group (millipedes, centipedes & woodlice) www.bmig.org.uk
- Butterfly Conservation SW Scotland Branch www.southwestscotland-butterflies.org.uk
- Dipterists Forum (flies) www.dipteristsforum.org.uk
- UK Moths www.ukmoths.org.uk

4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk
- Buglife Scotland (01786) 447504 www.buglife.org.uk
- Butterfly Conservation Scotland (0870) 7706151 www.butterflyconservation.org

FISHES

Corkwing Wrasse, an abundant fish of shallow waters on rocky coasts. (Paul Naylor)

1. Status and Distribution

The UK has a relatively limited freshwater fish fauna compared with most of Europe, with around 30 species. At least another 330 species of fish have been recorded in UK coastal waters.

Dumfries and Galloway supports possibly the most diverse range of freshwater fish in Scotland, although this includes many introductions, most of them brought in for angling purposes. Habitat requirements vary greatly and most species require different habitats for different stages of their life history, though unpolluted water is a requirement for all. In general terms, river fishes require a continuous flow; oxygen-rich water at suitable temperature and pH levels; a range of water depths and velocities; in-stream cover and overhanging vegetation; suitable substrates for reproduction; and adequate access to the right micro habitats at the right time of year. Fish of standing waters have different requirements, but all sizes of waterbody from ponds to large lochs, with all but the most extreme of nutrient levels, are capable of supporting fish communities.

The sand and mud flats of the Solway support a wide range of marine species and are particularly important spawning and nursery grounds for demersal (bottom-dwelling) species such as Plaice *Pleuronectes platessa* and Common Sole *Solea vulgaris*. More than 130 species have been recorded, including a greater number of tropical or tropical marine species than many other parts of Scotland. These have included Swordfish *Xiphias gladius*, Sunfish *Mola mola*, a number of tunnys and sharks, and even seahorses. This is probably because its waters are the most northerly of the shallow warm waters of the Irish Sea, before the relatively deep colder waters of the North Channel. Rocky species, such as Conger Eel *Conger conger* and many wrasses, are also represented in the west but, not surprisingly, pelagic species (fish that swim in mid-water) and deep water species are not recorded in large numbers.

The coastal waters of Dumfries & Galloway do not support a large commercial fishery. Recreational fishing of both coastal and freshwaters is, however, more important to the local economy. Direct expenditure on angling was estimated to be worth almost £6.75m to Dumfries & Galloway in 2003, including more than £1m on coarse fishing. In addition to Salmon *Salmo salar* and Trout *Salmo trutta*, game fish include the Grayling *Thymallus thymallus* introduced to the Nith and Annan. Coarse species include Pike *Esox lucius,* Perch *Perca fluviatilis* and Roach *Rutilus rutilus*.

Lamprey from Water of Fleet. (Galloway Fisheries Trust).

2. Threats

- **Pollution** is a serious threat to all fish. This can arise from accidental spillages, both at sea and in freshwaters, but diffuse pollution may have more widespread and longer-term implications.
- Global **overfishing** of certain species reduces overall stocks, affecting local distributions.
- **Acidification** of freshwaters has had a serious impact in certain locations.
- **Obstacles** on watercourses can restrict or prevent migration.
- Escapes from fish farms may reduce the genetic integrity of native fish stocks.
- **Introduced species**, both non-native fish and non-fish species such as North American Signal Crayfish, pose a threat to some fish populations.

- Most UK freshwaters are free of serious **diseases**, but *Gyrodactylosis* and other diseases has been found elsewhere in Europe and has the potential to spread to Scotland, wiping out stocks completely.

Atlantic Salmon from the River Dee. (Galloway Fisheries Trust)

3. Opportunities

- Improve habitat management of river catchments and coastal areas. This should include habitats that are some distance from water, but may have an impact.
- Improve fisheries management to ensure that decisions are taken that benefit a wide range of species and the wider environment, rather than just the target fish species.
- Encourage fisheries managers and anglers to take all necessary precautions to prevent the introduction or transfer of diseased fish.

4. Further Information

4.1 Publications

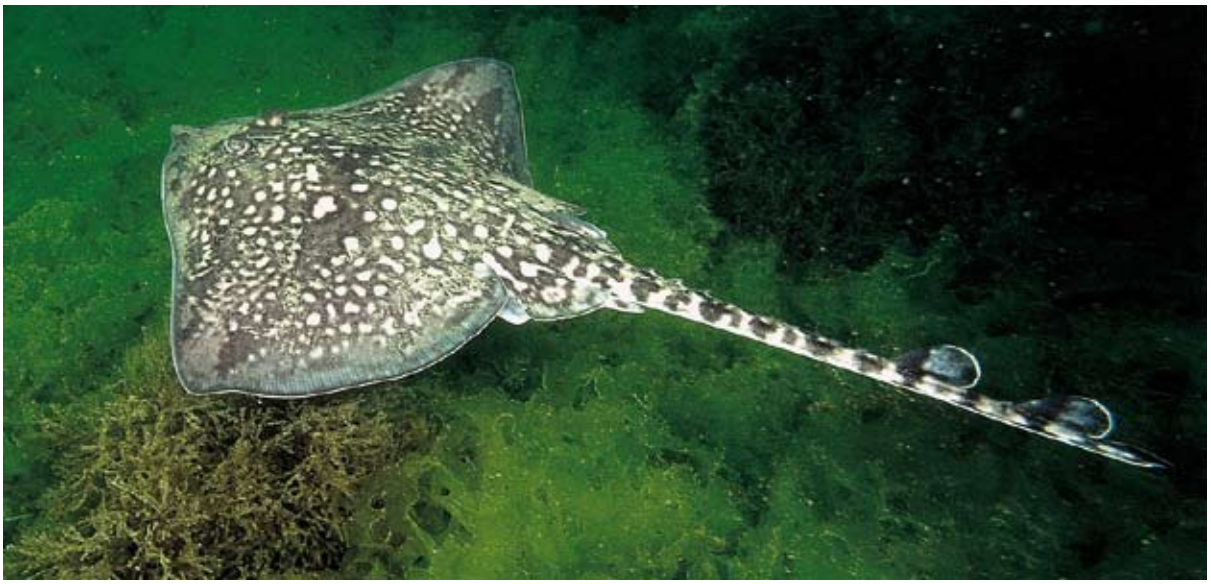
Scottish Natural Heritage (2007) *River Bladnoch SAC Atlantic Salmon Catchment Management Plan.* Scottish Natural Heritage, Battleby.

4.2 Websites

- Association of Salmon Fishery Boards http://asfb.hub.uk.com/
- Atlantic Salmon Trust www.atlanticsalmontrust.org
- Scottish Freshwater Fisheries Management www.sffm.org.uk/
- Shark Trust www.sharktrust.org
- Wild Trout Trust www.wildtrout.org

4.3 Advisory Organisations

- District Salmon Fishery Boards (see ASFB above website for current contact details)
- Galloway Fisheries Trust (01671) 403011 www.gallowayfisheriestrust.org
- Fisheries Research Services (01224) 876544 www.frs-scotland.gov.uk
- Scottish Natural Heritage (01387) 247010 www.snh.org.uk



Thornback Ray, common in both deep and shallow coastal waters. (Paul Naylor)

REPTILES & AMPHIBIANS

1. Status and Distribution

Common Frog. Lochmaben, June 2007. (Paul McLaughlin)

Some 85 species of non-marine reptile and 45 species of amphibian are found in Europe. Mainly for climatic reasons, Britain has only 6 non-marine native reptiles and 6 native amphibians, and though all 6 amphibians occur in Scotland, only 3 of the reptiles do so. In addition there are records of a few introduced species (of which 1 or 2 species in England may prove to be native), and records of 5 species of sea turtle in British waters.

Dumfries & Galloway is the only part of Scotland to support all Scottish native species of reptile and amphibian: Common or Viviparous Lizard *Zootoca vivipara*, Slow Worm *Anguis fragilis*, Adder *Vipera berus,* Great Crested Newt *Triturus cristatus*, Smooth Newt *Lissotriton vulgaris*, Palmate Newt *Lissotriton helvetica*, Common Toad *Bufo bufo*, Natterjack Toad *Epidalea calamita*, and Common Frog *Rana temporaria*. All these species occur most frequently along the Solway coast, but Common Lizard, Adder, Palmate Newt, Common Toad and Common Frog are more widespread, sometimes extending well into the Southern Uplands.

Common Lizard on fence post at Drumlanrig, April 2007. (Pete Robinson).

In addition there are a few unconfirmed records of Grass Snake *Natrix natrix*, and records of all of the marine turtles. Indeed, records of Leatherback Turtle *Dermochelys coriacea* are now so frequent that it is no longer considered to be just a rare visitor, but an integral part of the region's marine fauna.

2. Threats

- The public perception of reptiles, and to a lesser extent, amphibians, is not generally favourable. This sometimes results in deliberate killing.
- Habitat fragmentation has resulted in the isolation of some populations.

3. Opportunities

- Create ponds and wetlands in gardens, farms and forests. Together with associated habitat management, these significantly boost local populations of some amphibians.
- Raise the public profile of amphibians and reptiles, and their role in ecosystems.

Young Adder. (Pauline Spilling)

4. Further Information

4.1 Publications

- Beebee, T. & Denton, J. (1996) *The Natterjack Toad Conservation Handbook*. English Nature, Peterborough.
- Gent, T. & Gibson, S. (eds.) (1998) *The Herpetofauna Workers' Manual*. Joint Nature Conservation Committee, Peterborough.
- Langton, T., Beckett. C., & Foster, J. (2001) *Great Crested Newt Conservation Handbook*. Froglife, Halesworth.

4.2 Websites

- Amphibian & Reptile Groups of the UK www.arg-uk.org.uk
- British Herpetological Society www.thebhs.org
- Froglife www.froglife.org
- Herpetological Conservation Trust www.herpconstrust.org.uk
- National Amphibian & Reptile Recording Scheme www.narrs.org.uk

4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk

BIRDS

1. Status and Distribution

Whooper Swan. (Gordon McCall)

Approximately 700 species of bird are known from Europe, and 514 of these have been recorded in Scotland. This is a relatively small total compared to parts of Africa and South America, but British birds are the most highly studied species group in the world. In Dumfries & Galloway around 350 species of birds have been recorded. Of these, some 160 are known to have bred at some time during the last 100 years.

The most important habitats in the region for birds are the coasts and estuaries, and the many freshwater wetlands. Collectively these support internationally important numbers of overwintering and migrating wildfowl and wading birds. The Solway is regarded as one of the most important estuaries for birds in Europe and is particularly associated with Svalbard Barnacle Geese *Branta leucopsis,* with virtually the entire world population wintering on the Solway. The region's uplands are also important for breeding Hen Harriers *Circus cyaneus* and Peregrines *Falco peregrinus*. A number of wetland and upland sites have been designated as Special Protection Areas for their bird interest.

Black Grouse (Northeastwildlife.co.uk)

Other important populations include Barn Owls *Tyto alba* and Black Grouse *Tetrao tetrix,* whilst Red Kites *Milvus milvus* have been successfully reintroduced. In addition, the region is near the northern British limit for some species, such as Nightjars *Caprimulgus europaeus* and Willow Tits *Poecile montanus*, and near the southern limit for others, such as Black Guillemots *Cephus grylle* and Black-throated Divers *Gavia stellata*.

2. Threats

- **Habitat change**, particularly as a result of agricultural change and afforestation.
- **Loss of food and disturbance** resulted from Cockle dredging in the Solway, prior to regulation being introduced.

Barn Owl, Paul McLaughlin

- Deliberate **persecution**, especially of birds of prey, reduced some species to extinction in the 19th century, and despite being illegal still limits some populations.
- **Climate change**, though likely to result in new species for Dumfries & Galloway, threatens others, particularly those that breed in the uplands or depend on food from the sea.

3. Opportunities

- Create new habitats such as wetlands and native woodlands. Most bird species respond to habitat creation much quicker than other species groups.
- Diversify existing habitats. Relatively small changes to the management of extensive habitats such as farmland and forests can often produce significant benefits for birds, such as Black Grouse.
- Encourage participation in the government-funded agri-environment schemes.
- Encourage public participation in web-based surveys such as RSPB's Garden BirdWatch, BTO surveys or BBC surveys.

4. Further Information

4.1 Publications

- Dickson, R. C. (1994) *The Birds in Wigtownshire*. GC Publishers, Wigtown.
- Dodds, G.W., Appleby, M.J. & Campbell, L. (1996) *A Management Guide to Birds of Upland Farmland*. RSPB, Sandy.
- Forrester, R. & Andrews, I. (eds)(2008) *The Birds of Scotland*. Scottish Ornithologists' Club, Edinburgh.
- Symes, N. & Currie, F. (2005) *Woodland Management for Birds*. RSPB & Forestry Commission England, Sandy.
- Winspear, R & Davies, G. (2005) *A Management Guide for Birds on Lowland Farms*. RSPB, Sandy.
- Various editors. (from 1985) Annual Dumfries & Galloway Regional Bird Reports.

4.2 Websites

- British Trust for Ornithology www.bto.org
- Scottish Ornithologists Club www.the-soc.zenwebhosting.com

4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk
- RSPB Scotland, Dumfries & Galloway (01556) 670464 www.rspb.org.uk
- Wildfowl and Wetlands Trust, Caerlaverock (01387) 770200 www.wwt.org.uk

Peregrine Falcon. (Laurie Campbell)

MAMMALS

The current status of Water Voles in Dumfries & Galloway is unclear. (Environment Agency)

1. Status and Distribution

More than 300 species of wild mammal have been recorded in Europe. The mammal fauna of Britain is considerably impoverished in comparison, amounting only to around 100 species. At least 79 of these are known from Scotland, though some of the bats, seals, whales and dolphins from only a handful of sightings. This impoverishment is largely due to the cutting of the land bridge between Britain and Europe soon after the end of the last Ice Age, before a number of species had managed to reach Britain. However all of the major mammal groups are present and British mammals are perhaps the best-studied on Earth.

Fifty-two species of mammal have been recorded from Dumfries & Galloway in recent times, as follows:

Insectivores	5
Bats	8
Lagomorphs (rabbits & hares)	3
Rodents	9
Carnivores	9
Ungulates (deer etc)	6
Seals	2
Cetaceans (whales & dolphins)	c10

Of these, at least 12 have been deliberately or accidentally introduced by man. A number of other species are known to have existed in historical times, but are now extinct. Compared to the rest of Scotland, Dumfries & Galloway has an especially rich bat fauna, and is the only area with recent reports of Harvest Mice.

Most terrestrial native mammals evolved in woodland habitats, and most remain associated with trees. However, a number such as bats, Badgers, Red Deer and Red Squirrels have successfully adapted to highly-modified habitats including conifer plantations, farmland and even urban areas.

2. Threats

- There is a **lack of knowledge** of distribution, abundance and population trends for the majority of species in Dumfries & Galloway.
- A number of **non-native mammals** threaten native species. For example, Sika Deer and Red Deer, Grey Squirrels and Red Squirrels, and Mink and Water Voles.
- **Loss of habitat**, especially wetlands and native woods, has particularly affected some insectivores and bats that are dependent on the abundant invertebrate food associated with these habitats.

Grey Seal (Gordon McCall)

- The use of **toxic chemicals** in wetlands, farmland, gardens and in buildings has seriously reduced populations of some species, although this has become much less of a threat in recent years and some populations, such as Otters, have dramatically recovered.
- An **absence of natural predators** for larger herbivores such as deer and goats can lead to abnormally high populations that cause serious damage to semi-natural habitats, reduced animal health and ultimately to population crashes.

- A high incidence of **road deaths**, particularly affecting Hedgehogs, Badgers and Otters. The A75 is one of the worst roads in Scotland for mammal road kills. However, there is no evidence that this is having a serious overall impact on local populations.
- A poor **public perception** of some species, especially bats.

Leisler's Bats in box at Buchan Wood, Glentrool. (Pete Robinson)

3. Opportunities

- Increase the recording of mammals in the region by training people in identification and recording methods, utilising local bat, squirrel and mammal groups and Dumfries & Galloway Environmental Resources Centre.
- Eradication of non-native invasive mammals is unlikely to be possible. Monitor their distribution and carry out localised control programmes, using humane methods that are likely to be most effective to sustain native mammal populations.
- Take account of mammal requirements in habitat management.
- Carry out humane control of deer and goats to maintain populations that in balance with habitats.
- Where possible, install mammal underpasses on roads with a high incidence of mammal kills. Greatest opportunities arise when new sections of road are constructed.
- Continue the educational work of organisations such as the Dumfries & Galloway Bat Group to raise awareness of species that can be encouraged by the public.

4. Further Information

4.1 Publications

- Corbet, G. B. & Harris, S. (1991) *The Handbook of British Mammals* (3rd Edition). Blackwell, London.
- Entwistle, A. C., Harris, S., Hutson, A. M., Racey, P. A., Walsh, A., Gibson, S. D., Hepburn, I. & Johnston, J. (2001) *Habitat Management for Bats. A guide for land managers, land owners and their advisors*. JNCC, Peterborough.
- Forestry Commission, Bat Conservation Trust, Countryside Council for Wales and English Nature (2005) *Woodland Management for Bats*. Forestry Commission, Wetherby.
- Strachan, R. (1998) *Water Vole Conservation Handbook*. Wildlife Conservation Research Unit, Oxford.

4.2 Websites

- Badger Trust www.badger.org.uk
- British Deer Society www.bds.org.uk
- Mammal Society www.abdn.ac.uk/mammal
- Mammals Trust UK www.mtuk.org
- SeaWatch Foundation www.seawatchfoundation.org.uk
- Whale & Dolphin Conservation Society www.wdcs.org

4.3 Advisory Organisations

- Scottish Natural Heritage (01387) 247010 www.snh.org.uk
- Scottish Badgers www.scottishbadgers.org.uk
- Bat Conservation Trust Scotland (01786) 826 792 www.bats.org.uk
- Deer Commission Scotland (01463) 725000 www.dcs.gov.uk
- Red Squirrels in South Scotland www.red-squirrels.org.uk

BIODIVERSITY INDICATORS

Monitoring of progress against this action plan will be carried out using an online national system called Biodiversity Action Reporting System (BARS). Many of the LBAP partners also carry out their own biodiversity monitoring and much of this is collated by the Dumfries & Galloway Environmental Resources Centre. However, it is not feasible to monitor and record everything. Therefore, in order to judge the overall effectiveness of LBAP activities monitoring of a suite of indicators will provide guidance on the main biodiversity trends.

There are 68 indicators set out in the UK Sustainable Development Strategy covering a broad canvas of social and economic activity. Of these, only a handful relate directly to biodiversity. There are four indices relating to bird populations and one each to biodiversity action, fish stocks and river quality. The Scottish Government is signed up to this strategy, but has also published its own Sustainable Development Strategy (Choosing our Future), and its own Biodiversity Strategy. In the latter, two kinds of indicator are described, biodiversity state indicators and biodiversity engagement indicators.

- Biodiversity state indicators are measures of abundance or diversity of species groups, extent and quality of habitats, and abundance of key biological indicators as a measure of wider ecosystem health.
- Biodiversity engagement indicators are measures of understanding of, and engagement with, biodiversity on an individual (personal and professional) and an organisational level. They also aim to examine how this affects actions and decisions of individuals and organisations.

It is important to ensure that local indicators relate to those being used at national level, so that the same information, once collected can be used to indicate a variety of different trends at different geographical scales. LBAP indicators should be able to contribute to the measurement of progress on other regional programmes where they will form a sub set of a wider indicator series. For example on sustainability within the Dumfries & Galloway Community Planning process.

For biodiversity state indicators to be of use the challenge is to have adequate data on abundance and distribution. For biodiversity engagement indicators, sufficient quantity and quality of data is required.

Biodiversity indicators for Dumfries and Galloway are as follows:

Biodiversity State indicators

1. **Abundance of selected breeding birds** (e.g. Hen Harrier Red Kite) as monitored annually by Dumfries & Galloway Raptor Study Group/RSPB.
2. **Abundance of selected non-breeding waterbirds** (e.g. Barnacle Goose) as monitored annually through monthly winter counts by the Wetland Bird Survey/WWT/RSPB/JNCC.
3. **Abundance of breeding seabirds** as monitored by full seabird surveys across Scotland every 15 years, augmented by annual surveys of a sample of colonies by JNCC/RSPB.
4. **Vascular plant diversity in selected 10km squares** as monitored BSBI Atlas and local change data.
5. **Proportion of notified species populations in favourable condition on protected sites** as monitored every 6 years by SNH.
6. **Proportion of notified habitat area in favourable condition on protected sites** as monitored every 6 years by SNH.
7. **Salmonid counts** in main rivers as monitored annually be District Salmon Fisheries Boards/ Galloway Fisheries Trust.
8. **Freshwater invertebrate diversity** at selected sites as monitored annually by SEPA.
9. **Cockle stock assessment** as monitored annually by Solway Shellfish Management Association/Freshwater Research Services.
10. **Cetacean sightings** as monitored annually by volunteer Cetacean Group/SeaWatch Foundation.

Biodiversity Engagement indicators

11. **Number of visitors to nature reserves** as monitored annually by WWT/RSPB/SNH/Forestry Commission.
12. **Number of people involved in biodiversity recording** as monitored by Dumfries & Galloway Environmental Resources Centre.
13. **Number of registered Eco-Schools and levels of awards** as monitored by Eco Schools.

APPENDICES

Appendix 1

Local Priority Habitats - Criteria for selection

All UK Priority Habitats, or their nearest equivalents, that occur in Dumfries & Galloway have been selected as Local Priority Habitats.

Appendix 2

List of Local Priority Habitats

Subtidal Rock
Subtidal Sands and Gravels
Intertidal Sand and Mud Flats
Seagrass Beds
Intertidal Rocky Shores
Honeycomb Worm Reefs
Coastal Shingle Beaches
Coastal Sand Dunes
Coastal Saltmarshes (Merse)
Coastal Cliffs and Slopes
River Headwaters
Lowland Rivers and Backwaters
Exposed River Shingle
Eutrophic Lochs
Mesotrophic Lochs
Oligotrophic Lochs
Reedbeds
Fens
Marshes
Upland Springs and Flushes
Raised Bogs
Purple Moor-Grass and Rush Pastures
Blanket Bogs
Calcareous Grasslands
Neutral Grasslands
Acid Grasslands
Inland Rock Outcrops
Montane Moss-heaths
Upland Heaths
Native Wet Woods
Native Ash Woods
Native Oak Woods
Native Birch Woods
Forest Ponds
Wood Pastures and Parklands
Arable Fields
Traditional Field Boundaries
Farm Ponds
Traditional Orchards
Industrial and Post-industrial Sites
Urban Watercourses and Wetlands

Appendix 3

Local Priority Species - Criteria for selection

1. National Importance

UK Priority Species and species on the Scottish Biodiversity List that occur in Dumfries & Galloway on a permanent/semi-permanent/regular basis (i.e. not as rare vagrants).

2. Local Importance in a National Context

Any species not included above for which Dumfries & Galloway supports 30% or more of the UK population *or*
A UK nationally rare or UK nationally scarce species for which Dumfries & Galloway supports 75% or more of the Scottish population.

3. Local Rarity

Species that have less than 100 individuals *or*
Occur in only 1 or 2 10km squares in Dumfries & Galloway.

4. Local Decline

Species that have declined in numbers or range as a result of human activity by 10% or more during any period in the last 100 years, or species threatened with decline on this scale.

5. Local Distinctiveness

Species that are characteristic of Dumfries & Galloway.

Note: Evidence to support the above criteria should be observed and documented wherever possible. However estimated, inferred or suspected evidence may be acceptable if documented evidence is not available, if agreed by local experts. Population can be measured either in terms of absolute numbers or distribution (i.e. number of sites or OS grid squares occupied)

Appendix 4

List of Local Priority Species

Note: Future amendments to the Scottish Biodiversity List and the UK Biodiversity Action Plan may result in modifications to the list of Local Priority Species for Dumfries & Galloway. Please check the website for an up to date list.

Fungi

A slime mould ***Craterium muscorum***	A slime mould ***Diderma ochraceum***
Willow Gloves *Hypocreopsis lichenoides*	A fungus ***Fayodia bisphaerigera (gracilipes)*** (SBL)
Dung Bird's-nest *Cyathus stercoreus* (SBL)	A fungus ***Inocybe calospora***
A fungus ***Galerina stylifera***	**Golden Bootleg** *Phaeolepiota aurea*
A fungus ***Rimbachia bryophila*** (SBL)	A fungus ***Aleurodiscus wakefieldiae*** (SBL)
Zoned Tooth Fungus Hydnellum concrescens (UKBAP/SBL)	A fungus ***Rhodocybe gemina*** (SBL)
Scarlet Elf Cup *Sarcoscypha coccinea* (SBL)	**Oak Polypore** *Piptoporus quercinus (Buglossoporus pulvinus)* (SBL)
Beeswax Bracket *Ganoderma pfeifferi*	

Lichens

Sap-groove Lichen *Bacidia incompta* (UKBAP/SBL)	A lichen ***Biatoridium monasteriense*** (UKBAP/SBL)
Churchyard Lecanactis Lecanographa grumulosa (SBL)	**Orange-fruited Elm Lichen** *Caloplaca luteoalba* (UKBAP/SBL)
A lichen ***Caloplaca britannica*** (SBL)	A lichen ***Cladonia peziziformis*** (UKBAP/SBL)
A lichen ***Collema fasciculare*** (SBL)	A lichen ***Degelia ligulata*** (SBL)
A lichen ***Fuscopannaria sampaiana*** (SBL)	A lichen ***Hypotrachyna sinuosa*** (SBL)
A lichen ***Hypotrachyna taylorensis*** (SBL)	A lichen ***Lecanographa amylacea (Lecanactis amylacea)*** (SBL)
A lichen ***Lecanora albella*** (SBL)	A lichen ***Lempholemma intricatum*** (SBL)
A lichen ***Leptogium britannicum*** (SBL)	A lichen ***Leptogium burgessii*** (SBL)
A lichen ***Leptogium cyanescens*** (SBL)	**Tree Lungwort Lichen** *Lobaria pulmonaria* (SBL)
A lichen ***Lobaria amplissima*** (SBL)	A lichen ***Lobaria scrobiculata*** (SBL)
A lichen **Lobaria virens** (SBL)	A lichen ***Menegazzia terebrata*** (SBL)
A lichen ***Micarea stipitata*** (SBL)	A lichen ***Pannaria conoplea*** (SBL)
A lichen ***Pannaria rubiginosa*** (SBL)	A lichen ***Parmeliella parvula*** (SBL)
A lichen ***Parmeliella testacea*** (SBL)	A lichen ***Parmeliella triptophylla*** (SBL)
A lichen ***Peltigera collina*** (SBL)	A lichen ***Porina hibernica*** (SBL)
Norwegian Specklebelly *Pseudocyphellaria norvegica* (UKBAP/SBL)	A lichen ***Ramalina fraxinea*** (SBL)
Speckled Script Lichen *Schismatomma graphidioides* (UKBAP/SBS)	A lichen ***Schismatomma cretaceum*** (SBL)
A lichen ***Stenocybe septata*** (SBL)	A lichen ***Sticta fuliginosa*** (SBL)
A lichen ***Sticta canariensis*** (SBL)	A lichen ***Sticta sylvatica*** (SBL)
A lichen ***Sticta limbata*** (SBL)	A lichen ***Synalissa symphorea*** (SBL)
A lichen ***Usnea ceratina*** (SBL)	A lichen ***Usnea florida*** (SBL)
A lichen ***Gyalidea roseola*** (SBL)	

Seaweeds

A red seaweed ***Drachiella heterocarpa***	A red seaweed ***Spyridia filamentosa***

Mosses

Cernuous Bryum *Bryum uliginosum* (UKBAP)	**Don's Thread-moss** *Bryum donianum* (SBL)
Many-seasoned Thread-moss *Bryum intermedium* (SBL)	**Silky Swan-neck Moss** *Campylopus setifolius* (SBL)
Spruce's Bristle-moss *Orthotrichum sprucei* (SBL)	**Rugged Collar-moss** *Splachnum vasculosum*
Bent-moss *Campylostelium saxicola* (SBL)	**Yellowish Fork-moss** *Dichodontium flavescens* (SBL)
Whip Fork-moss *Dicranum flagellare* (SBL)	**Hasselquist's Hyssop** *Entosthodon fascicularis* (SBL)
Varnished Hook-moss (Slender-green Feather Moss) *Hamatocaulis vernicosus* (SBL)	**Flood-moss** *Myrinia pulvinata* (SBL)
Long-leaved Fork-moss *Paraleucobryum longifolium* (SBL)	**Oval-leaved Pottia** *Pterygoneurum ovatum* (SBL)
Megapolitan Feather-moss *Rhynchostegium megapolitanum* (SBL)	**Water Grimmia** *Schistidium agassizii* (SBL)
Compact Grimmia *Schistidium confertum* (SBL)	**Tufted Feather-moss** *Scleropodium cespitans* (SBL)
Glass-wort Feather-moss *Scleropodium tourettii* (SBL)	**Baltic Bog-moss** *Sphagnum balticum* (SBL)

Vascular Plants & Ferns

Shady Horsetail *Equisetum pratense*	**Wilson's Filmy-fern** *Hymenophyllum wilsonii*
Royal Fern *Osmunda regalis*	**Marsh Fern** *Thelypteris palustris* (SBL)
Holly-fern *Polystichum lonchitis* (SBL)	**Hay-scented Buckler Fern** *Dryopteris aemula*
Oblong Woodsia *Woodsia ilvensis* (UKBAP/SBL)	**Pillwort** *Pilularia globulifera* (UKBAP/SBL)
Juniper *Juniperus communis* (UKBAP/SBL)	**Hairy Buttercup** *Ranunculus sardous* (SBL)
Greater Celandine *Chelidonium majus* (SBL)	**Globeflower** *Trollius europaeus*
Least Water-lily *Nuphar pumila*	**Prickly Poppy** *Papaver argemone* (SBL)
Purple Ramping-fumitory *Fumaria purpurea* (UKBAP/SBL)	**White Ramping-fumitory** *Fumaria capreolata* (SBL)
Wild Cabbage *Brassica oleracea* (SBL)	**White Mustard** *Sinapis alba* (SBL)
Charlock *Sinapis arvensis* (SBL)	**Swine-cress** *Coronopus squamatus* (SBL)
Field Pepperwort *Lepidium campestre* (SBL)	**Early Dog-violet** *Viola reichenbachiana* (SBL)
Wild Pansy *Viola tricolour* (SBL)	**Imperforate St John's-wort** *Hypericum maculatum subsp. maculatum*
Mistletoe *Viscum album* (SBL)	**Sticky Catchfly** *Lychnis viscaria*
Isle of Man Cabbage *Coincya monensis* subsp. *monensis*	**Alpine Mouse-ear** *Cerastium alpinum*
Shepherd's Cress *Teesdalia nudicaulis* (SBL)	**Annual Knawel** *Scleranthus annuus* (SBL)
Good-King-Henry *Chenopodium bonus-henricus* (SBL)	**Prickly Saltwort** *Salsola kali* (SBL)
Long-stalked Orache *Atriplex longipes*	**Early Orache** *Atriplex praecox*
Perennial Flax *Linum perenne* (SBL)	**Sea Stork's-bill** *Erodium maritimum* (SBL)
Long-stalked Crane's-bill *Geranium columbinum* (SBL)	**Spiny Restharrow** *Ononis spinosa* (SBL)
Small Restharrow *Ononis reclinata* (UKBAP/SBL)	**Purple Oxytropis** *Oxytropis halleri* (UKBAP/SBL)

Wood Bitter-vetch *Vicia orobus* (SBL)	**Bithynian Vetch** *Vicia bithynica* (SBL)
Yellow-vetch *Vicia lutea* (SBL)	**Sea Pea** *Lathyrus japonicus* (SBL)
Narrow-leaved Everlasting-pea *Lathyrus sylvestris* (SBL)	**Strawberry Clover** *Trifolium fragiferum* (SBL)
Slender Trefoil *Trifolium micranthum* (SBL)	**Harsh Downy-rose** *Rosa tomentosa* (SBL)
Dewberry *Rubus caesius* (SBL)	**Hoary Cinquefoil** *Potentilla argentea* (SBL)
Mossy Saxifrage *Saxifraga hypnoides* (SBL)	**Blunt-fruited Water-starwort** *Callitriche obtusangula* (SBL)
Sea-holly *Eryngium maritimum* (SBL)	**Wild Celery** *Apium graveolens* (SBL)
Whorled Carraway *Carum verticillatum*	**Tubular Water-dropwort** *Oenanthe fistulosa* (SBL)
Rock Samphire *Crithmum maritimum* (SBL)	**Spignel** *Meum athamanticum*
Sun Spurge *Euphorbia helioscopia* (SBL)	**Cornfield Knotgrass** *Polygonum rurivagum* (SBL)
Black-bindweed *Fallopia convolvulus* (SBL)	**Black-poplar** *Populus nigra* (SBL)
Downy Willow *Salix lapponum* (SBL)	**Whortle-leaved Willow** *Salix myrsinites*
Bog Rosemary *Andromeda polifolia*	**Intermediate Wintergreen** *Pyrola media* (SBL)
Rock Sea Lavender *Limonium recurvum* ssp. *humile* (SBL)	**Scarlet Pimpernell** *Anagallis arvensis* (SBL)
Lesser Centaury *Centaurium pulchellum* (SBL)	**Common Gromwell** *Lithospermum officinale* (SBL)
Oysterplant *Mertensia maritima*	**Henbane** *Hyoscyamus niger* (SBL)
An eyebright ***Euphrasia rostkoviana ssp. montana***	An eyebright ***Euphrasia anglica*** (SBL)
An eyebright ***Euphrasia frigida***	**Yellow Bartsia** *Parentucellia viscosa* (SBL)
Ivy Broomrape *Orobanche hederae* (SBL)	**Greater Broomrape** *Orobanche rapum-genistae* (SBL)
Large-flowered Hemp-nettle *Galeopsis speciosa* (SBL)	**Field Woundwort** *Stachys arvensis* (SBL)
Hoary Plantain *Plantago media* (SBL)	**Clustered Bellflower** *Campanula glomerata* (SBL)
Rampion Bellflower *Campanula rapunculus* (SBL)	**Ivy-leaved Bellflower** *Wahlenbergia hederacea* (SBL)
Field Madder *Sherardia arvensis* (SBL)	**Dwarf Elder** *Sambucus ebulus* (SBL)
Golden-samphire *Inula crithmoides* (SBL)	**Common Cudweed** *Filago vulgaris* (SBL)
Heath Cudweed *Gnaphalium sylvaticum* (SBL)	**Milk Thistle** *Silybum marianum* (SBL)
Cornflower *Cenaurea cyanus* (UKBAP/SBL)	**Saw-wort** *Serratula tinctoria* (SBL)
Chicory *Cichorium intybus* (SBL)	**Smooth Cat's-ear** *Hypochaeris glabra* (SBL)
Hawkweed Oxtongue *Picris hieracioides* (SBL)	**Northern Hawk's-beard** *Crepis mollis* (SBL)
Esthwaite Waterweed *Hydrilla verticillata* (SBL)	**Shinning Pondweed** *Potamogeton lucens*
Slender Naiad *Najas flexilis* (UKBAP/SBL)	**Bluebell** *Hyacinthoides non-scripta* (UKBAP/SBL)
Field Garlic *Allium oleraceum* (SBL)	**Bog Orchid** *Hammarbya paludosa*
Common White Orchid *Pseudorchis albida*	**Lesser Butterfly-orchid** *Platanthera bifolia* (SBL)
Greater Butterfly-orchid *Platanthera chlorantha* (SBL)	**Round-fruited Rush** *Juncus compressus*
Alpine Rush *Juncus alpinoarticulatus*	**Elongated Sedge** *Carex elongata* (SBL)
Sheathed Sedge *Carex vaginata*	**Dotted Sedge** *Carex punctata* (SBL)
Hair Sedge *Carex capillaris*	**Black Alpine Sedge** *Carex atrata*
Tufted-Sedge *Carex elata* (SBL)	**Confused Fescue** *Festuca lemanii*
Holy-grass *Hierochloe odorata*	**Soft Brome** *Bromus hordeaceus subsp. thominei*
Rye Brome *Bromus secalinus* (SBL)	**Alpine Foxtail** *Alopecurus borealis*

Invertebrates

Wine-glass Hydroid *Obelia bidentata*	A pond snail ***Lymnaea burnetti***
Medicinal Leech *Hirundo medicinalis*	
Lilljeborg's Whorl Snail *Vertigo lilljeborgi*	**Narrow-mouthed Whorl Snail** *Vertigo angustior* (UKBAP/SBL)
Freshwater Pearl Mussel *Margaritifera margaritifera* (UKBAP/SBL)	**Native (Flat) Oyster** *Ostrea edulis* (UKBAP/SBL)
Swan mussel *Anodonta cygnea* (SBL)	A bivalve mollusc ***Pisidium henslowanum*** (SBL)
A woodlouse ***Armadillidium album***	**Tadpole Shrimp** *Triops cancriformis* (UKBAP/SBL)
A money spider ***Mecopisthes peusi***	A money spider ***Gongylidiellum murcidum***
A money spider ***Erigone welchi***	A money spider ***Maro lepidus***
A money spider ***Centromerus levitarsis*** (SBL)	A money spider ***Neriene radiata***
A mesh-web spider ***Argenna patula***	A running foliage spider ***Agraecina striata***
A foliage spider ***Clubiona norvegica***	A jumping spider ***Talavera petrensis***
A jumping spider ***Sitticus floricola***	**Azure Hawker** *Aeshna caerulea*
Hairy Dragonfly *Brachytron pratense*	**Variable Damselfly** *Coenagrion pulchellum*
Speckled Bush Cricket *Leptophyes punctatissima* (SBL)	**Bog Bush Cricket** *Metrioptera brachyptera* (SBL)
A ground beetle ***Blethisa multipunctata***	A ground beetle ***Dyschirius angustatus*** (SBL)
A ground beetle ***Dyschirius nitidus***	A ground beetle ***Perileptus areolatus*** (SBL)
A ground beetle ***Aepus robini***	A ground beetle ***Thlalassophilus longicornis***
A ground beetle ***Bembidion nigricorne***	A ground beetle ***Bembidion testaceum*** (UKBAP/SBL)
A ground beetle ***Pterostichus anthracinus***	A ground beetle ***Lebia chlorocephala***
A crawling water beetle ***Haliplus apicalis*** (SBL)	A whirligig beetle ***Gyrinus distinctus*** (SBL)
Smaller Noterus ***Noterus crassicornis*** (SBL)	A diving beetle ***Copelatus haemorrhoidalis*** (SBL)
A diving beetle ***Bidessus minutissimus*** (UKBAP/SBL)	A diving beetle ***Hygrotus versicolor*** (SBL)
A diving beetle ***Hydroporus elongatulus*** (SBL)	***Hydroporus longulus*** (SBL)
A diving beetle ***Hydroporus rufifrons*** (UKBAP/SBL)	A diving beetle ***Porhydrus lineatus***
A diving beetle ***Agabus conspersus***	A diving beetle ***Agabus uliginosus*** (SBL)
A diving beetle ***Ilybius fenestratus***	A diving beetle ***Ilybius subaeneus***
A diving ***Rhantus suturalis*** (SBL)	A water beetle ***Hydraena pulchella*** (SBL)
A small water beetle ***Hydraena pygmaea*** (SBL)	A small water beetle ***Hydraena testacea***
A small water beetle ***Ochthebius auriculatus*** (SBL)	A water beetle ***Helophorus alternans*** (SBL)
A water beetle ***Helophorus fulgidicollis***	A water beetle ***Helophorus tuberculatus*** (SBL)
A water beetle ***Hydrochus angustatus*** (SBL)	A water beetle ***Hydrochus brevis*** (SBL)
A water beetle ***Anacaena limbata*** (SBL)	A water beetle ***Laccobius atratus*** (SBL)
A water beetle ***Helochares punctatus*** (SBL)	A water beetle ***Enochrus testaceus*** (SBL)
A water beetle ***Cercyon convexiusculus*** (SBL)	A water beetle ***Cercyon depressus*** (SBL)
A water beetle ***Cercyon melanocephalus*** (SBL)	A water beetle ***Cercyon quisquilius*** (SBL)
A water beetle ***Megasternum obscurum*** (SBL)	A water beetle ***Sphaeridium scarabaeoides*** (SBL)
A rove beetle ***Carpelimus schneideri***	A rove beetle ***Omalium rugulipenne***
A click beetle ***Negastrius sabulicola*** (UKBAP/SBL)	A marsh beetle ***Elodes pseudominuta*** (SBL)
A water beetle **Cyphon kongsbergensis** (SBL)	A water beetle ***Cyphon ochraceus*** (SBL)
A water beetle ***Cyphon punctipennis*** (SBL)	A water beetle ***Cyphon pubescens*** (SBL)
A water beetle ***Scirtes hemisphaericus*** (SBL)	A long-toed water beetle ***Dryops nitidulus*** (SBL)
A long-toed water beetle ***Dryops similaris*** (SBL)	A water beetle ***Heterocerus fossor*** (SBL)
A water beetle ***Augyles (Heterocerus) maritimus*** (SBL)	A water beetle ***Plateumaris rustica*** (SBL)
A flower beetle ***Oedemera virescens*** (UKBAP/SBL)	A darkling beetle ***Eledona agricola***
Musk Beetle *Aromia moschata*	**Water-Lily Reed Beetle** *Donacia crassipes* (SBL)

A reed beetle ***Donacia impressa*** (SBL)	A reed beetle ***Donacia marginata*** (SBL)
A reed beetle ***Donacia obscura*** (SBL)	A reed beetle ***Donacia thalassina*** (SBL)
Six-spotted Pot Beetle *Cryptocephalus sexpunctatus* (UKBAP/SBL)	A leaf beetle ***Macroplea appendiculata***
A weevil ***Notaris bimaculatus*** (SBL)	A weevil ***Poophagus sisymbrii*** (SBL)
Water Plantain Weevil *Bagous alismatis*	A weevil ***Thryogenes nereis*** (SBL)
A weevil ***Melanapion minimum*** (UKBAP/SBL)	A weevil ***Procas granulicollis*** (SBL)
A weevil ***Trachodes hispidus***	**Sphagnum Bug** *Hebrus ruficeps* (SBL)
River Skater *Aquarius najas* (SBL)	A pond skater ***Gerris gibbifer*** (SBL)
An aquatic bug ***Plea minutissima*** (SBL)	A micro moth *Scrobipalpa clintoni*
Red-tipped Clearwing ***Synanthedon formicaeformis***	**Forester** *Adscita statices* (SBL)
Narrow-bordered Bee Hawk-moth *Hemaris tityus* (UKBAP/SBL)	**Barred Tooth-stripe** *Trichopteryx polycommata* (SBL)
Bilberry Pug *Chloroclystis debiliata*	**Argent and Sable Moth** *Rheumaptera hastata* (UKBAP/SBL)
Square-spotted Clay *Xestia rhomboidea* (SBL)	**Broad-bordered White Underwing** *Anarta melanopa*
Sword-grass *Xylena exsoleta* (UKBAP/SBL)	**Dingy Skipper** *Erynnis tages tages* (SBL)
Northern Brown Argus *Articia artaxerxes* (UKBAP/SBL)	**Pearl-bordered Fritillary** *Boloria euphrosyne* (UKBAP/SBL)
Small Pearl-bordered Fritillary *Boloria selene*	A caddisfly ***Phacopteryx brevipennis***
A cranefly ***Tipula hortorum***	A cranefly ***Lipsothrix errans*** (UKBAP/SBL)
A cranefly ***Prionocera pubescens*** (SBL)	A cranefly ***Nephrotoma scurra*** (SBL)
A cranefly ***Nigrotipula nigra*** (SBL)	A cranefly ***Limonia magnicauda*** (SBL)
A fungus gnat ***Urytalpa macrocera***	A horsefly ***Haematopota bigoti***
Black Deerfly Chrysops sepulchralis	
Northern Silver Stilleto-fly *Spiriverpa (Thereva) lunulata* (SBL)	A dolichopodid fly ***Dolichopus latipennis***
A flat-footed fly ***Callomyia elegans***	A hoverfly ***Anasimyia lunulata***
A hoverfly ***Cheilosia latifrons*** (SBL)	A hoverfly ***Parhelophilus consimilis***
A hoverfly ***Pipizella maculipennis***	A hoverfly ***Platycheirus europaeus***
A hoverfly ***Platycheirus immarginatus***	A fly ***Acanthocnema glaucescens***
A mayfly ***Kageronia (Heptagenia) fuscogrisea***	A ruby-tailed wasp **Chrysura hirsuta** (UKBAP/SBL)
Hairy Wood Ant *Formica lugubris* (UKBAP/SBL)	**Negro Ant** *Formica fusca* (SBL)
A spider-hunting wasp ***Evagetes crassicornis*** (SBL)	**Red-banded Sand Wasp** *Ammophila sabulosa* (SBL)
A digger wasp ***Crabro peltarius*** (SBL)	**Common Spiny Digger Wasp** *Oxybelus uniglumis* (SBL)
Northern Colletes Bee *Colletes floralis* (UKBAP/SBL)	A mining bee ***Colletes fodiens*** (SBL)
Short Horned Yellow-Face Bee *Hylaeus brevicornis* (SBL)	A mining bee ***Lasioglossum fulvicorne*** (SBL)
A mining bee ***Lasioglossum villosulum*** (SBL)	A cuckoo bee ***Sphecodes gibbus*** (SBL)
A cuckoo bee ***Stelis punctulatissima*** (SBL)	**Wool-Carder Bee** *Anthidium manicatum* (SBL)
Wall Mason Bee *Osmia parietina* (UKBAP/SBL)	A cuckoo bee ***Epeolus variegatus*** (SBL)
A cuckoo bee ***Nomada roberjeotiana*** (SBL)	A cuckoo bee ***Nomada leucophthalma*** (SBL)
A cuckoo bee ***Nomada obtusifrons*** (SBL)	**Shrill Carder Bee** *Bombus sylvarum* (UKBAP)

Fishes

Sea Lamprey *Petromyzon marinus* (SBL)	**River Lamprey** *Lampetra fluviatilis* (SBL)
Brook Lamprey *Lampetra planeri* (SBL)	**Basking Shark** *Cetorhinus maximus* (UKBAP/SBL)
Tope *Galeorhinus galeus*	**Spurdog** *Squalus acanthias*
Common Skate *Dipturus batis* (SBL)	**European Eel** *Anguilla anguilla* (SBL)
Twaite Shad *Alosa fallax* (SBL)	**Allis Shad** *Alosa alosa* (UKBAP/SBL)
Smelt (Sparling) *Osmerus eperlanus* (SBL)	**Vendace** *Coregonus albula* (UKBAP/SBL)
Atlantic Salmon *Salmo salar* (SBL)	**Lesser Sand-eel** *Ammodytes tobianus* (SBL)
Plaice *Pleuronectes platessa* (SBL)	

Birds

Black-throated Diver *Gavia arctica* (SBL)	**Whooper Swan** *Cygnus cygnus* (SBL)
White-fronted Goose (Greenland race) *Anser albifrons* (SBL)	**Barnacle Goose** (Svalbard race) *Branta leucopsis* (SBL)
Scaup *Aythya marila* (SBL)	**Common Scoter** *Melanitta nigra* (UKBAP/SBL)
Osprey *Pandion haliaetus* (SBL)	**Golden Eagle** *Aquila chrysaetos* (SBL)
Red Kite *Milvus milvus* (SBL)	**Marsh Harrier** *Circus aeruginosus* (SBL)
Merlin *Falco columbarius* (SBL)	**Peregrine Falcon** *Falco peregrinus* (SBL)
Common Kestrel *Falco tinnunculus* (SBL)	**Hen Harrier** *Circus cyaneus* (SBL)
Black Grouse *Tetrao tetrix* (UKBAP/SBL)	**Grey Partridge** *Perdix perdix* (UKBAP/SBL)
Lapwing *Vanellus vanellus* (SBL)	**Golden Plover** *Pluvialis apricaria* (SBL)
Dotterel *Charadrius morinellus* (SBL)	**Dunlin** *Calidris alpina* (SBL)
Bar-tailed Godwit *Limosa lapponica* (SBL)	**Black-tailed Godwit** *Limosa limosa* (SBL)
Curlew *Numenius arquata* (SBL)	**Woodcock** *Scolopax rusticola* (SBL)
Herring Gull *Larus argentatus* (SBL)	**Black-headed Gull** *Larus ridibundus* (SBL)
Little Tern *Sterna albifrons* (SBL)	**Common Tern** *Sterna hirundo* (SBL)
Arctic Tern *Sterna paradisaea* (SBL)	**Sandwich Tern** *Sterna sandvicensis* (SBL)
Nightjar *Caprimulgus europaeus* (UKBAP/SBL)	**Short-eared Owl** *Asio flammeus* (SBL)
Barn Owl *Tyto alba* (SBL)	**Kingfisher** *Alcedo atthis* (SBL)
Swift *Apus apus* (SBL)	**Skylark** *Alauda arvensis* (UKBAP/SBL)
Reed Warbler *Acrocephalus scirpaceus* (SBL)	**Song Thrush** *Turdus philomelos* (UKBAP/SBL)
Ring Ouzel *Turdus torquatus* (SBL)	**Wood Warbler** *Phylloscopus sibilatrix* (SBL)
Spotted Flycatcher *Muscicapa striata* (UKBAP/SBL)	**Willow Tit** *Poecile montanus* (SBL)
Chough *Pyrrhocorax pyrrhocorax* (SBL)	**Common Starling** *Sturnus vulgaris*
House Sparrow *Passer domesticus*	**Tree Sparrow** *Passer montanus* (UKBAP/SBL)
Twite *Carduelis flavirostris*	**Linnet** *Carduelis cannabina* (UKBAP/SBL)
Siskin *Carduelis spinus* (SBL)	**Bullfinch** *Pyrrhula pyrrhula* (UKBAP/SBL)
Yellowhammer *Emberiza citrinella*	**Reed Bunting** *Emberiza schoeniclus* (UKBAP/SBL)
Corn Bunting Miliaria calandra (UKBAP/SBL)	

Reptiles

Adder *Vipera berus*	**Leatherback Turtle** *Dermochelys coriacea* (UKBAP/SBL)

Amphibians

Great Crested Newt *Triturus cristatus* (UKBAP/SBL/EPS)	**Natterjack Toad** *Epidalea calamita* (UKBAP/SBL/EPS)

Mammals

Water Vole *Arvicola terrestris* (UKBAP/SBL)	**Brown Hare** *Lepus europaeus* (UKBAP/SBL)
Mountain Hare *Lepus timidus* (SBL)	**Otter** *Lutra lutra* (UKBAP/SBL/EPS)
Common Pipistrelle *Pipistrellus pipistrellus* (SBL/EPS)	**Soprano Pipistrelle** *Pipistrellus pygmaeus* (UKBAP/SBL/EPS)
Brown Long-eared Bat *Plecotus auritus* (SBL/EPS)	**Daubenton's Bat** *Myotis daubentonii* (SBL/EPS)
Whiskered Bat *Myotis mystacinus* (SBL/EPS)	**Natterer's Bat** *Myotis nattereri* (SBL/EPS)
Noctule Bat *Nyctalus noctula* (SBL/EPS)	**Leisler's Bat** *Nyctalus leisleri* (EPS)
Red Squirrel *Sciurus vulgaris* (UKBAP/SBL)	**Bottle-nosed Dolphin** *Tursiops truncatus* (UKBAP/SBL)
Common Dolphin *Delphinus delphis* (SBL)	**Harbour Porpoise** *Phocoena phocoena* (UKBAP/SBL)
Killer Whale *Orcinus orca* (SBL)	**Minke Whale** *Balaenoptera acutorostrata* (SBL)

Additional species: The following species/species groups were identified as being important to the Scottish public in the Scottish Biodiversity Strategy. They are generally widespread, common in Dumfries & Galloway, though no more so than most other parts of Scotland. They are not considered to be locally threatened.

Oak Quercus spp (SBL)	**Heather** *Calluna vulgaris* (SBL)
Harebell *Campanula rotundifolia* (SBL)	**Thistle** (SBL)
Robin *Erithacus rubecula* (SBL)	**Badger** *Meles meles* (SBL)
Roe Deer *Capreolus capreolus* (SBL)	**Red Deer** *Cervus elaphus* (SBL)

Abbreviations

BTO	British Trust for Ornithology
EPS	European Protected Species
EU	European Union
FWAG	Farming and Wildlife Advisory Group
JNCC	Joint Nature Conservancy Council
LBAP	Local Biodiversity Action Plan
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MCA	Marine Consultation Area
NNR	National Nature Reserve
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SBL	Scottish Biodiversity List
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SNH	Scottish Natural Heritage
SPA	Special Protection Area
Sp.	Species (singular)
Spp.	Species (plural)
SSSI	Site of Special Scientific Interest
SUDS	Sustainable Urban Drainage Scheme
UKBAP	United Kingdom Biodiversity Action Plan
WWT	Wildfowl & Wetlands Trust